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WOODWORKING MACHINERY

WOODWORKING MACHINERY

A COMPREHENSIVE SURVEY FOR WOODWORKING MACHINISTS, FOREMEN AND EXECUTIVES

BY

H. R. HUDSON

WITH OVER 150 ILLUSTRATIONS

LONDON
GEORGE NEWNES LIMITED
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STRAND, W.C.2

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PREFACE

IN preparing this book, great care has been taken to cover just those points upon which experience has shown information is most frequently required by joiners, carpenters, cabinet makers, and all those engaged in the woodworking trades.

During the past fifteen years, many improvements and refinements have been made in the design of woodworking machinery, the greatest advance being in the self-contained electric motor drive. Improved tools, safer guards, and ball bearings have all added to the efficiency and reduction of accidents and noise.

In Chapter I the Rising Top Saw Bench has been widely dealt with and its many uses fully explained.

The following chapters give a very detailed treatment of the Travelling Head Crosscut Saws, Surface Planers, Mortising Machines, Band Sawing Machines, Planing and Thicknessing Machines, Tenoning Machines, etc.

Operators will find that, although each machine is fully dealt with, this book forms an excellent introduction to more advanced works such as the Vertical Spindle Moulder. The highly skilled operators of this machine should find the information given invaluable.

Chapter X deals fully with the Universal Woodworker, a machine which, while combining the operations of many single machines, has an efficiency and compactness that will be appreciated in the small shop.

In conclusion, it is hoped that the reader will find the information contained in this book of real utility as well as of interest.

H. R. HUDSON.

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CHAPTER I.

THE RISING-TOP SAW BENCH

A GOOD working knowledge of woodworking machinery is to-day of prime importance to every progressive joiner, cabinet maker and all others engaged in the woodworking trade. In the following pages it is proposed to deal in a clear practical manner with the constructional details and operation of all types of modern woodworking machines.

The present chapter deals with the rising-top saw bench which has almost entirely superseded the rising-spindle saw which, owing to its unwieldy countershaft and driving belt, added considerably to running costs and occupied valuable space.

As the spindle in the rising-top saw bench remains in a fixed position, a small unit electric motor can be used to give a direct or vee-belt drive to the saw. For purposes of operation, the chief consideration is the alteration in the distance from the spindle to the bench.

Rising-top saw benches are made in all sizes to carry up to 42-in. saws, and mostly used by joiners. Cabinet makers and others using the smaller sizes up to 32-in. diameter, are advised to purchase a saw bench with rising top, especially if it is the only saw bench in the shop. Even in heavy work it is often useful for rebating, grooving, shouldering, etc.

Advantage of Two Speeds

The rising-top saw bench is capable of a great variety of work, and if no other machine is available it is invaluable. Under such circumstances, its efficiency will be greatly increased if it can be run at two speeds. The old rising-spindle machine, when using a countershaft, often had this advantage by means of cone or step pulleys.

When the saw is driven by belt from a common lineshaft, two speeds are hardly practicable. If driven direct by belt from an engine, some variation of speed may be secured by altering the throttle or governors of the engine. The electric motor overcomes the difficulty either with a two-speed motor, or, if belt-driven from motor to saw, by having step pulleys on the motor and saw spindle—dispensing with a loose pulley altogether.

If, for one reason or another, the saw bench can only have one speed, remember that the speed has to suit the largest saw. For this reason many comparatively small shops, having a large saw bench, find it advisable to install a small one for odd jobs.

Points to Look for in a Saw Bench

Where it is intended to install a saw bench decide first the maximum depth to be cut. In the country, away from sawmills, one has to be prepared for more deep sawing, but in small shops near a town, a deep cut is a rare event.

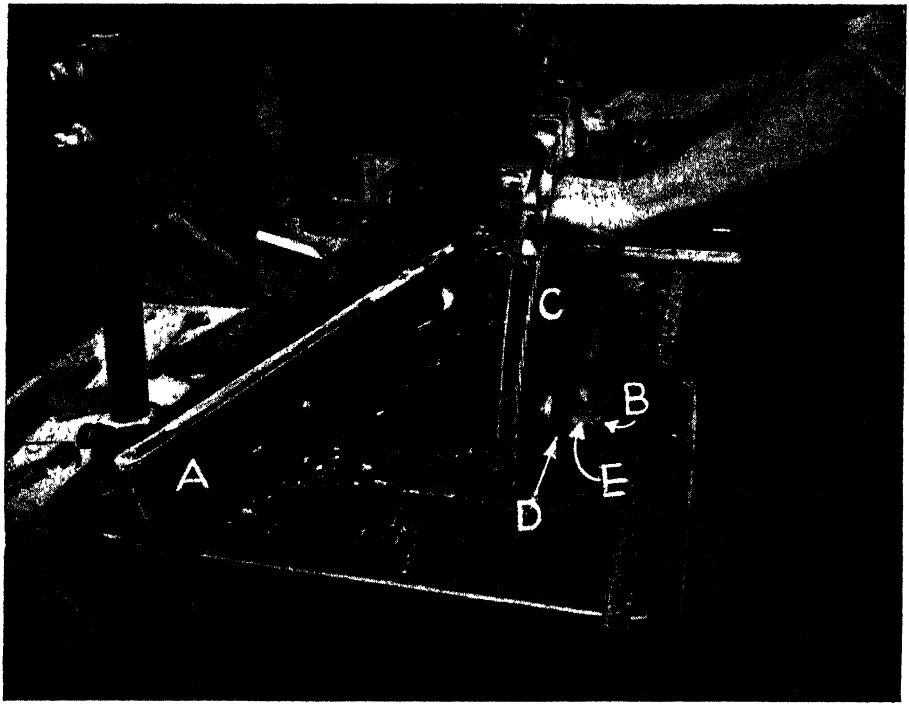

Fig. 1.—FITTING A CIRCULAR SAW TO RISING-TOP BENCH

Finger plate A is shown removed, exposing the spindle B. The circular saw C is placed on the spindle, then the washer D and finally the nut E, which is shown being tightened.

There must be sufficient weight in the various parts, without being clumsy. The spindle should not be too thin, table-raising gear easy and protected from sawdust, etc.

Ball bearings are essential as they do not wear excessively. The saw spindle will therefore maintain its alignment with fence and top.

The nut which fastens the saw on the spindle should have a left-hand thread. The fence must have a sliding front plate and be arranged to cant to various angles. A decent maximum width between saw and fence is an advantage in some trades, a groove on front edge of bench top, an adjustable saw guard and riving knife; and, if the spindle end is bored to carry boring and mortising bits, it is often useful.

Driving Gear

The pulleys should not be too small in either diameter or width of face; power is more essential than speed for sawing purposes. (The circular saw takes more power than most woodworking machines.) The loose pulley should have ball bearings, too. The belt-shifting gear and all adjustments of the fence should be easily accessible.

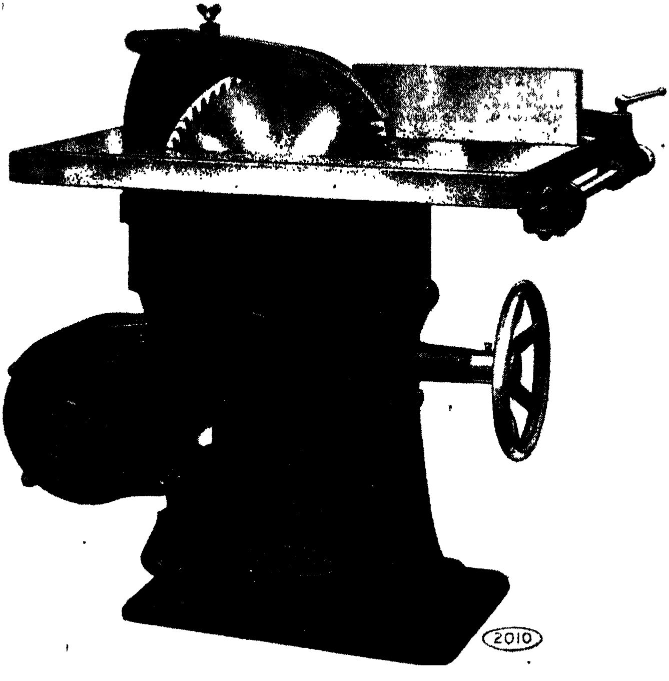

Fig. 2.—Circular Saw Bench

(*J. Sagar and Co., Ltd.*)

If purchased from a reliable maker, all these good points will be incorporated in any saw bench they offer, but this machine is so popular and necessary to most woodworkers that there have always been low-priced machines on the market whose only virtue is their low price. The latest woodworking machines are so much improved in every way that one ten years old will probably lack many essential good features.

Multiple endless vee belts are almost universally used on saw benches to-day, the motor is fixed on the back of the frame, or inside the frame of the smaller machines. Means are provided for adjusting the tension, but vee belts need not be really tight.

Vee belts are very efficient and much quieter than flat belts. They will work on pulleys at very short centres, which effects a great saving in floor space.

Packing the Saw

All saws should be packed—to support and steady them (packing is also used to correct faulty tension, but this applies mostly to larger saws than we are considering). Fix a strip of hardwood under the bench top on each side of the saw, but not touching it. Screws and tapped holes are provided for the purpose. These form a ledge to hold the packings, which should extend from the gullets nearly to the collar.

Saddler's felt, worsted or spun yarn wrapped around pieces of cardboard or thin wood and dipped in oil, make suitable packings. They should not be tighter than can be easily pushed down with the fingers. Fit a piece of wood into the gap from the packings to the end. This prevents the packings working forward into the teeth and keeps bits of wood from getting down and jamming the saw. It is not usual to pack the back half of the saw, excepting very large ones.

As the gauge or thickness of circular saws increases with their diameter, each saw requires packings to suit.

Fig. 3.—Operating the Circular Saw

Underneath the bench will be seen the wheel for operating the level of the table. The timber to be sawn is placed against the fence to keep it straight on the saw. Do not force the saw, but let it work easily, as by so doing the best results will be obtained. Note the improvised guard to prevent the sawdust from getting near the operator's feet. To comply with the Factories Act the saw guard should be adjusted to cover the teeth as much as possible, and the riving knife should be within ½ in. of the back of the saw.

Protection

Saw guards and riving knives are compulsory in this country; and most makers include them with the saw bench.

The riving knife is now usually separate from the guard; being fixed on a slide under the table top. This is the correct method. It *must* be in line with the saw, and should be adjusted ½-in. from the saw. Its purpose is to keep the cut open, and prevent the wood nipping the saw. When working a saw single handed, with a good knife behind and a push stick in front, reasonable safety is ensured. The knife also protects anyone pulling off.

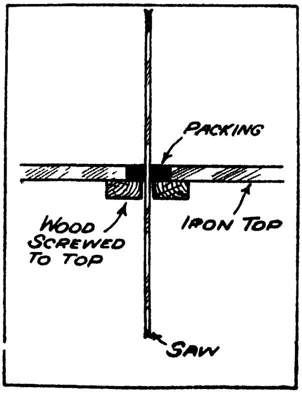

Fig. 4.—Method of Packing Circular Saws

Fix a strip of hardwood under the bench top on each side of the saw, but not touching it. Screws and tapped holes are provided for the purpose. These form a ledge to hold the packings, which should extend from the gullets nearly to the collar.

OPERATING THE SAW

Figs. 3 and 5 show how the saw is operated. Fig. 5 clearly shows the guard B and its holder, and the knife C. Fig. 3 shows a general view of the machine being worked.

An improvised guard to prevent the sawdust getting near to the operative's feet can be seen in this illustration. Too much sawdust should not be allowed to accumulate.

Ripping

Ripping is cutting timber lengthwise with the grain. Deep cutting is when the timber is on edge; flat cutting when it is cut with its larger dimension horizontal on the table.

Adjust the fence plate so that its front end is opposite the gullets of the teeth. If too far forward, the saw heats and binds and will not cut true. Feed the timber regularly as fast as you feel the saw is cutting—no saw should be forced, or can be forced effectively.

Possible Faults

If the saw loses speed or stops the following should be checked: feed too fast, lack of power, belt slip, saw blunt or not set sufficiently, fence not parallel

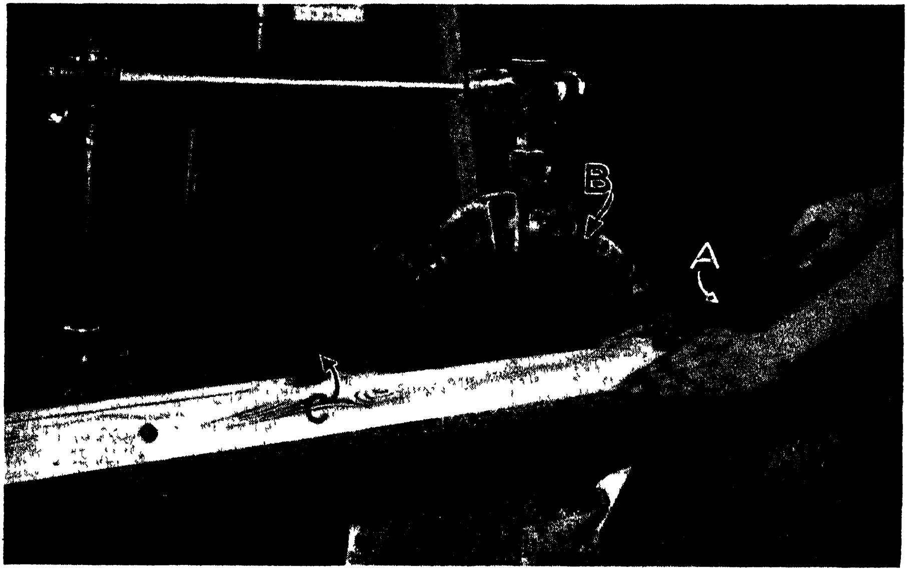

Fig. 5.—OPERATING THE CIRCULAR SAW

This clearly shows the guard B and its holder and the riving knife C, which should be in line with the saw. The purpose of the knife is to enter into the saw cut and to keep the joint open. Without such a provision, the timber would bind on to the saw and would be thrown upwards against the guard. The above also shows a push stick A, the use of which avoids the possibility of the operative's hands being cut when the end of the timber is near the saw. The guard is here shown raised. For the correct working position see Fig. 6.

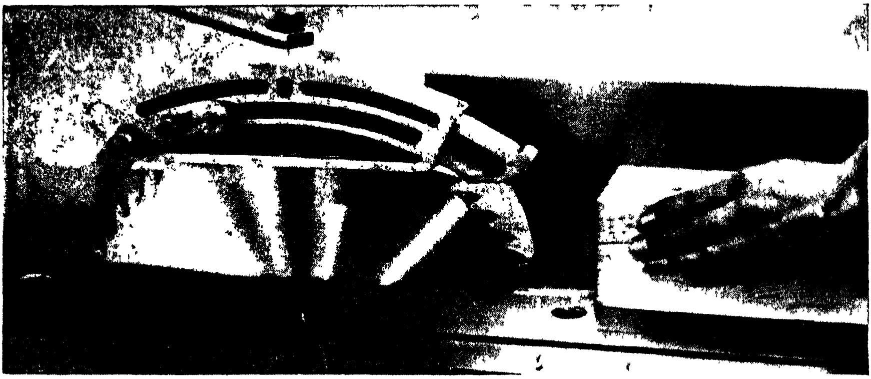

Fig 6.—Ripping
Showing correct positions of fence, guard and riving knife

Fig. 7.—Stoning Down a Saw with a Piece of Emery

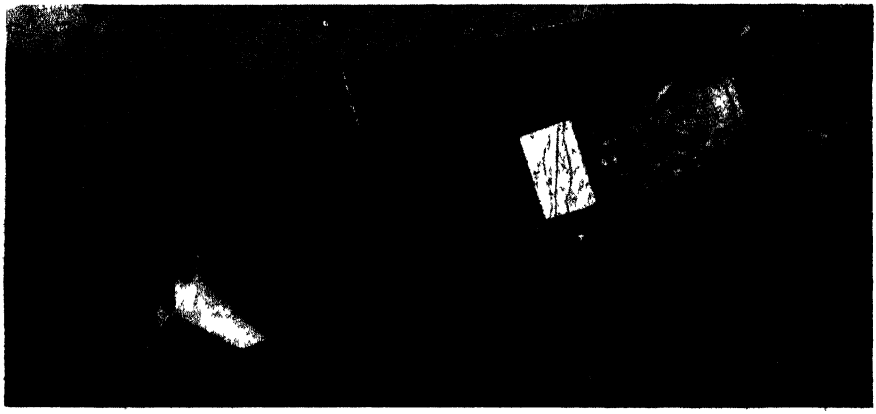

Fig. 8.—Using Canting Fence
Cutting two architraves out of one piece. Guard removed to show operation clearly.

with the saw and the timber wedging. There should be set screws behind the fence plate to remedy the latter fault. Measure between saw and table edge at both ends of the saw, and the saw and fence, or lay a straight edge along the saw face and measure whether the fence is parallel. Some sawyers always have the fence a trifle closer at the end nearest the saw. It will certainly not work if the back end of the fence is nearer the saw line.

Not Cutting Straight

If a saw is not cutting straight, the teeth on one side may have more set than those on the other side, or one side been sharpened more than the other. Run the saw two or three inches into a piece of wood and examine the cut to see whether right and left-hand teeth are cutting the same depth.

Stoning Down a New Saw

A new saw is seldom perfectly round and should be stoned down before being sharpened. Hold an emery stone on the table, square with the saw and lightly touch the tips of the teeth as the saw revolves. Do not allow the saw to cut a groove in the stone. Run the saw into the wood again and examine the cut. If cutting evenly sharpen each tooth to a point (Fig. 7).

This stoning down should be repeated after a saw has been sharpened a few times.

Dealing with Wet or Sticky Timber

Wet or sticky timber is difficult to saw. The teeth require more set. A tin with oil or paraffin and a stubby brush is useful to keep the teeth from getting gummed up.

Some timber has a tendency to close up behind the saw, but the riving knife, which is compulsory in this country, prevents this.

It must be in line with the saw.

Bevel Sawing

The cutting of timber into angular sections is done by setting the fence at the required angle to the table. When sawing heavy timber at an angle—keep it well up to the fence as it tends to push the saw forward. To be able to cut at an angle without any extra tackle is a great advantage and often effects a big saving in timber by diagonal cuts, for instance, two 3 × 1 moulds can be cut out of a piece of 3 × 1¼.

Cutting Wedges

Joiners especially use a lot of wedges of various sizes. Suppose some are required 4-in. long. Cross-cut some pieces 4-in. long and as thick as the tenon to be wedged. Cut a piece of board about a foot long and 3-in. or 4-in. wide, thicker than the wedges. Notch one corner of the board the shape of a wedge Lay it on the saw table with the notch to the left and from you. Nail a short handle at an angle to the centre of the template. Now set the fence so that the template will just slide between it and the saw, take one of the cross-cut pieces in your left hand with one end in the notch and saw it off. Turn the piece over and repeat, turning over each time. Adjustment of the fence to or from the saw will make the wedges any required size (see Fig. 15).

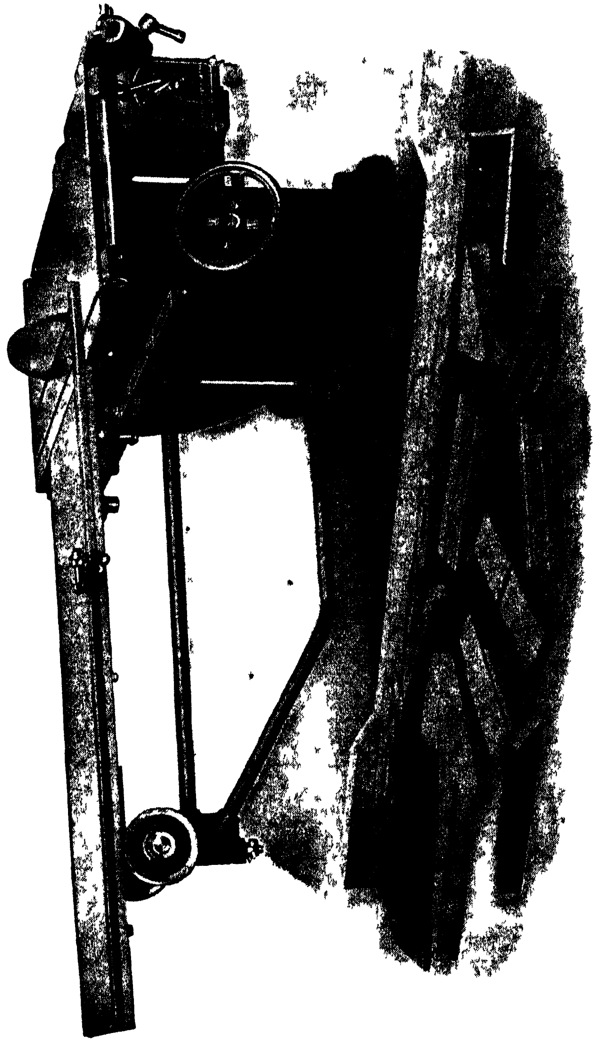

Fig 9 —DIMENSION SAW

A handy sliding table for squaring, dimension sawing, mitreing, etc Especially suitable for large flat pieces, plywood, wall boards, wardrobe doors, tops

(*Wilson Bros Ltd*)

Sawing to a Line

Sawing to a line is sometimes necessary, a coffin lid, hardwood planks, tapered pieces, etc. When sawing to a line it is best to stand well back so that the line and the saw can be sighted.

If having cut some distance the saw is running off the line, draw back and start again. Do not attempt to twist the saw in the cut. A strong saw with plenty of set is best if there is much of this to do.

Cross-Cutting

Cross-cutting can be done with any saw. Remove the fence, and it may be necessary to raise the table until it is above the pulleys and belt forks.

The beltless saw bench with an electric motor coupled to the saw spindle makes the cross-cutting of long timber impossible, owing to the motor standing above the level of the saw table; excepting with small saw benches when the lower-powered motor can be made with a frame small enough in diameter to be below the table top. Some machine makers have, therefore, designed machines with either chain or multi-vee belt drive, the motor being attached to the machine frame either at the side or end, thus retaining the self-contained features of a motorised saw but giving a clear top for cross-cutting. Care must be taken when cross-cutting long lengths of heavy section, as it is easy to buckle the saw.

Dimension Sawing

Cross-cutting to accurate limits, dimension sawing, is done best with a special saw, preferably a hollow-ground saw with moderate teeth. The hollow grinding, i.e., thicker at the tooth than at the collar, makes it possible to do without set on the teeth and gives a very clean finish to the cut.

These dimension saws are very responsive to careful sharpening and frequent "stoning down," and ends, shoulders and mitres, cut by them do not require any planing or trimming.

A dimension saw can with advantage be run much faster than an ordinary rip saw.

A slide is essential for dimension sawing, in fact for all cross-cutting it is a great help. For cross-cutting long timber a rough slide can be made of wood to go across the full width of the bench, and if there is much of this work and a new bench is being ordered, have a groove planed into the far edge of the table in addition to the one at the front. The ideal attachment for dimension sawing of anything more than small short stuff is the sliding table shown in Fig. 9.

Tenoning

Tenoning is done with the standard fence and one of the larger rip saws. Cut as for ripping with the face side to the fence, until the saw reaches the shoulder mark, then lift the back end up until the saw is at the shoulder mark on the other edge—cut the back cheeks first. The tenons can be shouldered with the dimension saw and the slide (see Figs. 12 and 13).

Two saws of equal diameter with a spacing washer between can be used for tenoning. The spacing washers must be as thick as the tenon plus twice the set of the saw. Tenoning on the saw bench saves a lot of setting out—it is only necessary to gauge the pattern to set the saw fence to.

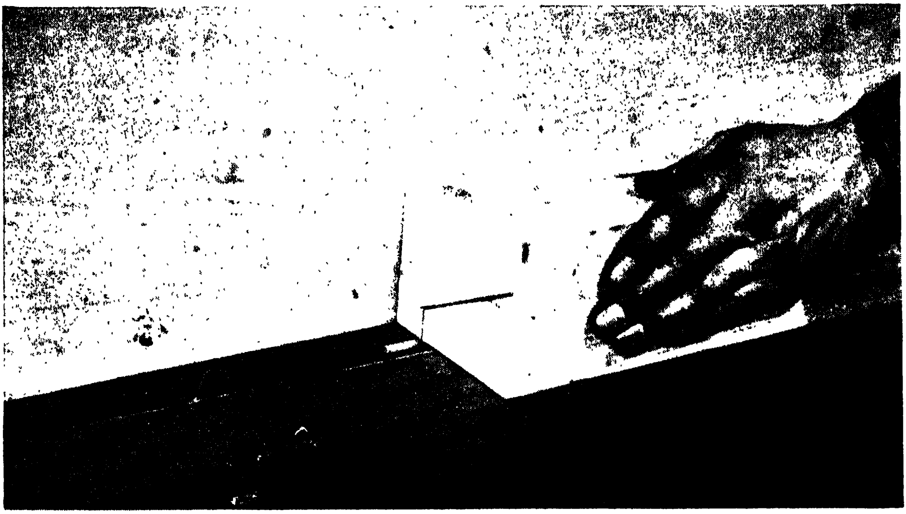

Fig. 10.—Rebating a Sill—First Cut
Long wood fence in use.

Short tenons can be cut by a trenching head if one is available, using the sliding table. The timber is laid flat and the shoulder is cut at the same operation.

Rebating

As we need the help of the fence until the timber leaves the saw and the iron fence will not go far enough forward, prepare a dry board, say 1¼-in. thick—planed straight and out of twist—and as long as the table, or at least to reach some inches beyond the back of the saw, and screw it to the iron fence. Keep this wood fence—it will be useful for many other jobs.

Use one of the smaller saws, and raise the table (or lower the spindle if the bench is old pattern) until the saw projects above the top as much as the depth of the required rebate, set the fence from the saw equal to the other dimension of the rebate, including, of course, the thickness of the saw. When all the pieces have been cut to this setting, raise or lower the table, set the fence and take the second cut. A push stick should be available to prevent the lath cut from shooting back as second cut is finished. A push stick should have a notch in the end and always be available when ripping or bevel cutting.

By canting the fence an angular rebate can be cut or a V can be taken out if wood spouting is required. Sills and transomes can be rebated and weathered.

Order of Cutting

The shallow cut should first be made, more particularly if the rebate is very deep one way. Suppose it is a sill of sticky pitch pine or coarse hard oak. If the shallow cut is made first, as the second cut is being made the piece which is being taken out can spring clear and relieve the saw; also if the deep cut is made first, when the sill is laid flat for the second cut, there is not much solid

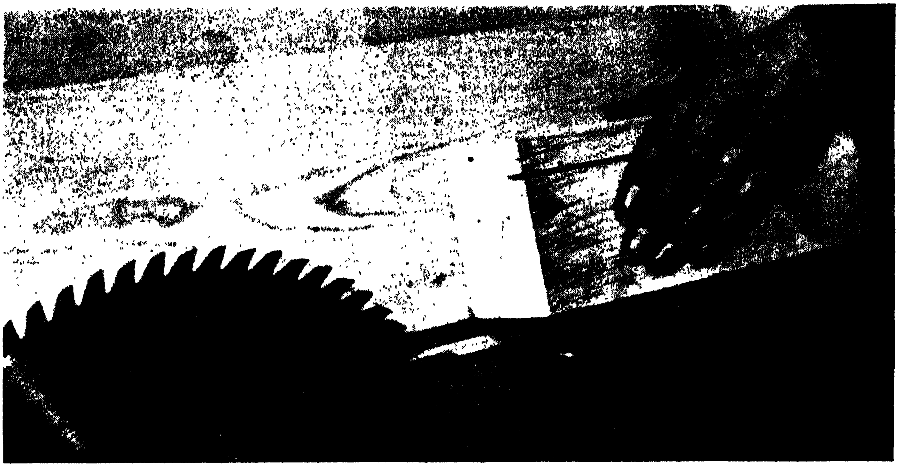

Fig. 11.—Rebating Sill—Second Cut
Long wood fence in use.

timber left and the piece will not keep level and cause the saw to undercut (not a fault in a sill if it has to be throated).

Ploughing

Ploughing can be done by several tools. Solid grooving saws, i.e., circular steel saws with teeth on, and as thick as the required plough groove, are not used as much to-day as formerly. One is required for each size of groove, they are rather costly, take a lot of power, and often burn unless carefully made, hollow ground and kept well sharpened.

The most useful and efficient tool is a wobble or drunken saw—it is quick, works freely and is easily sharpened. Any size groove can be made from the thickness of the saw (⅛-in.) up to 1½-in. or more, according to its diameter and speed. This is where two speeds are useful, and if the saw bench is a large one runs at a low speed, and is not arranged to run at two speeds, then either the grooving saws or the wobble saw must be greater in diameter than is otherwise necessary for the depth they have to cut—say 12-in. diameter.

Ploughing can be done with cutters (see later under "Moulding"). Use the long wood fence when ploughing.

Trenching Across the Grain

Trenching across the grain can be done with the wobble saw, if sharp; Huther pattern multiple grooving saws make a very good job as they can be built up in 1/16ths (see page 29). Dado or trenching heads are good too. A slide is necessary, an adjustable mitre fence will serve for narrow stuff, but for wide material a framed slide should be made to go right across the table. Hand screws or "G" cramps may then be used to hold the wood in position.

With long stuff a trestle is useful to support the outer end; some makers will supply a sliding table attachment for this purpose, this being fitted with fence and length gauges. For cutting plywood and other sheet material to accurate dimensions this attachment is ideal. If a hollow ground saw is used, veneered doors, tops and ends, and moulds, etc. can be squared or mitred with a perfectly planed finish.

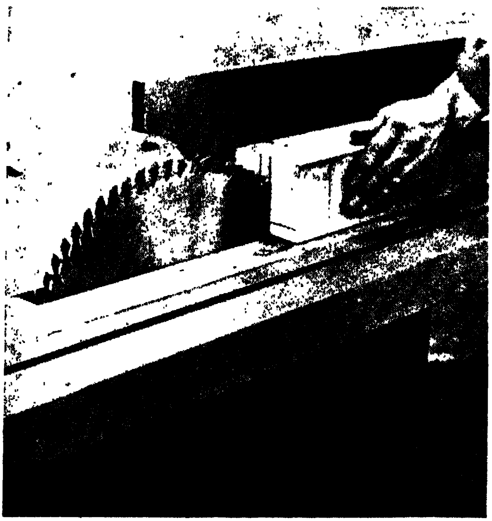

Fig 12.—TENONING WITH TWO SAWS (1)
First part of cut

Whitehill Cutter Heads

One of the best inventions in woodworking for many years, these heads have ousted the square cutter block on saw-benches (see page 74 for fuller details). On an 18-in. saw bench use a "Whitehill" 8-in., 9-in. or 10-in. diameter. A head 15/16-in. thick will do a lot of work but one 1¼-in. thick enables larger moulds to be worked. The cutters may project from the sides ⅛-in. or a little more on light work. A spacing washer may be needed between the fast collar and the cutter head to prevent the cutters fouling the table edge.

Moulding

Moulding is done on the rising-top saw bench, using a square steel cutter block on the spindle to which shaped cutters are bolted.

The cutter block should be about 4-in. square and 2-in. wide (or as wide as the length of the spindle will allow). A dovetail slot with bolt, nut and washer on each of its four faces; slotted cutters made of iron with steel face and ground to the required shape are bolted to the block. The cutters should be 4-in. to 4½-in. long, and must be used in pairs to preserve the balance. If the block is out of balance or cutters of unequal weight or length are used, it will set up vibration and spoil both the bearings and the work. The long wood fence must be used and a wood gap plate in place of the steel one (see note later).

Fig. 13.—TENONING WITH TWO SAWS (2)
The wood lifted to complete the cut.

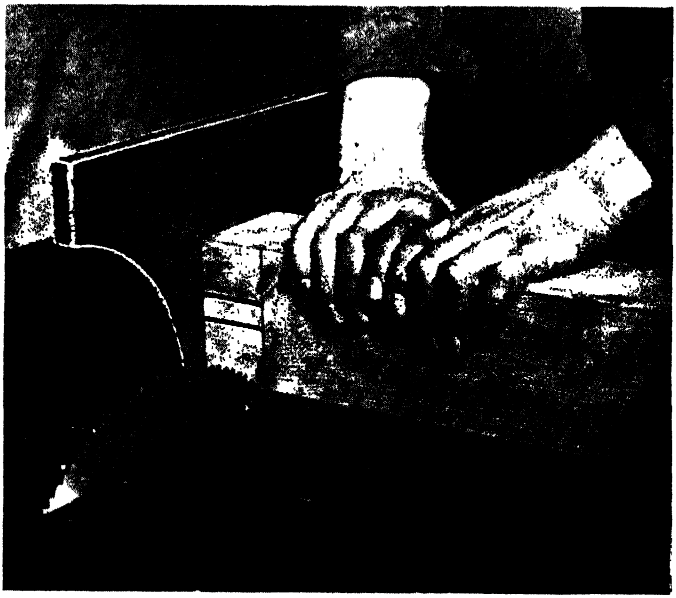

Fig. 14 —SHOULDERING THE TFNON

With hollow ground saw and sliding fence which is behind the wood and not seen.

Moulding *can* be done at the ordinary speed at which the saw runs, but the timber must be fed very slowly; a higher speed if available does a much better job and, of course, quicker.

Setting the Cutters for Moulding

The best way to set the cutters is to make a wood template out of a piece of thin board or plywood—shaped like a square with a blade about 3-in. square. Lay the template on the bench with the leg (like the stock of the square) towards you on your left, draw a line across the template 1-in. from and parallel to the inside edge of the "square"—this represents the top of the saw table in its lowest position and allows a little for loss of effective length of cutters—due to the angle at which they cut. This dimension is approximate and varies with thickness of bench top and size of cutter block. Keep the overhang of the cutters from the block as small as possible.

Put the cutter block in a vice with one face up and dovetail slot from you, apply the template so that the cutter block is in the "square" corner. Put a cutter on block, so that the shape of the mould is just above the table line on the template, and tighten the nut. *Always* put a double thickness of brown paper between cutter and block (see Fig. 16).

Before removing the template, run a fine pencil round the profile of the cutter; now turn the cutter block over, and using the template, fix the other cutter of the pair on the *opposite* face of the block *exactly* to the same marks on the template—both cutters *must* have the same projection so that both will cut and thus produce better work.

Fix the block on the spindle, adjust the fence and before starting the machine turn the spindle round by hand to make sure the cutters run clear of the table, etc. For some jobs another pair of cutters can be similarly fixed on the other two faces of the block, but the width is usually limited on a saw bench.

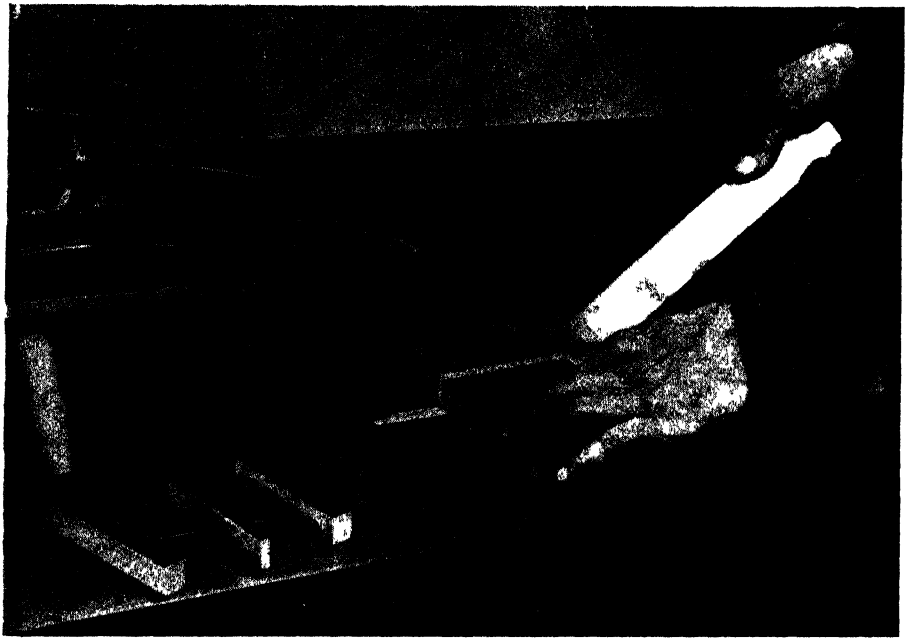

Fig. 15.—CUTTING WEDGES WITH TEMPLATE

Operating the Cutters

Whenever possible arrange the cutters so that they can work in the corner formed by the fence and table, and the face and edge of the wood are to table and fence, the timber then covers the cutters when working. If the mould involves a heavy cut, either take two cuts (by raising the table for the first) or cut a corner off the timber with the saw before moulding and so reduce the work of the cutters.

Cutting Very Small Moulds

For very small moulds such as beads, glass slips, angle fillets, etc., it is best to stick the mould on the four corners of larger pieces of wood and saw them off afterwards. Any mould which is difficult to handle can be run on two edges of a board and sawn off.

Rebating, Chamfering and Tongued and Grooved Joints done as Moulding

Rebating can be done as moulding by using square cutters and if you have a lotof it to do—put four cutters on, set very carefully so that all cut. The quality and quantity of the work will justify the trouble. Chamfering can be done with these rebating cutters by canting the fence. Tongued and grooved joints can also be done with suitable cutters.

Of course, for moulding, rebating, etc., a vertical spindle moulder is superior to the saw bench, but for fluting drainer boards or working any wide pieces the saw bench is quite suitable.

Special Gap Plates

The steel gap plate supplied with a saw bench cannot be used when ploughing, trenching or moulding, and a wooden one must be substituted; it is advisable to have several to suit the various jobs.

Suppose the wobble saw is to be used. Cut a piece of wood ¾-in. or 1-in. thick, a good fit to fill the gap, level with the table, fix the wobble saw on the spindle and set it to cut the required width of groove; raise the table so that the saw is quite clear of the underside. Now put the wood gap plate in and fix it either by means of a turn button under each end or put a weight on it. Start the machine and slowly lower the table allowing the saw to cut its way through until it projects a fraction higher than the required depth of groove—ease the table up so that the saw is not touching. You have now a gap as small as practicable for that job, which is safer. When moulding or trenching—proceed in the same way. If you have a small mould or groove to make and the gap plate has been used for a large job, screw a thin board on top and cut through in the same way.

Stopped Rebates, etc.

Stopped rebates, moulds, plough grooves, saw cuts, etc., can be done by "dropping on," as it is called. Use the long wood fence.

Suppose some doors with glass above the lock rail are being made with mould and rebate. The left-hand stiles are no trouble—simply start moulding at the top end and stop when it reaches the lock rail; but the right-hand stile has to be started at the middle. Place the bottom end of the stile on the saw table behind the cutters, holding it with the left hand and keeping the other end up above the table with the right hand. Now slowly lower the stile on to the cutters until the whole stile rests on the table and mould through to the end.

This operation needs care—keep a firm hold so that the wood is not thrown back when it touches the cutters. The centre cut

Fig. 16.—SETTING CUTTERS FOR MOULDING

Setting cutters with cutter block in vice. Note table line on wood template.

for the pocket in a pulley stile is cut with a small saw in the above manner.

Fig. 17.—MOULDING—SHOWING WOOD GAP PIECE

Other Operations

Boring, slot mortising and on some saw benches, hollow chisel mortising can be done, provided the end of the spindle is bored to carry the bits. An adjustable table to carry the timber during the operation must be provided.

Dowelling

For dowelling in cabinet making a plain top with adjustable fence parallel with the spindle is suitable.

Heavy Boring and Mortising

For heavy boring a sliding table, and for mortising a table with both lateral and forward movements with screw feed and a lever to move the table sideways for length of mortise, length and depth stops should be provided.

All these boring or mortising tables should have height adjustment.

These operations are not peculiar to a rising-top machine, but can be done on any saw bench suitably equipped.

Many of the operations mentioned can be done more easily on other machines, but where the rising-top saw bench is the only machine available, they may be carried out as described.

SAWS AND SHARPENING

A joiner's saw bench should have a general purpose rip saw big enough to give the deepest cut required with an inch or two to spare; they cut best when just through the timber and are always getting smaller with sharpening; and, say, two smaller rip saws for flat cutting and rebating.

All these should be standard gauge with "Briar" teeth. If much hardwood is used, a suitable tooth, stiffer and with less hook, will be an advantage. Thin saws certainly save timber, but require more skill and experience to use them.

Keep the saws sharp—95 per cent of saw troubles are due to either insufficient or improper sharpening or setting.

When the saw gets too warm or starts to turn away from the hard parts of timber, it is a sign that it needs sharpening.

When sharpening hold the saw in a suitable vice which supports it close to the teeth or the file will soon be spoilt.

Use a flat file with *round edges*, sharp angles in the gullets cause cracks, file the fronts of the teeth first, at a slight angle and well into the gullet, then a

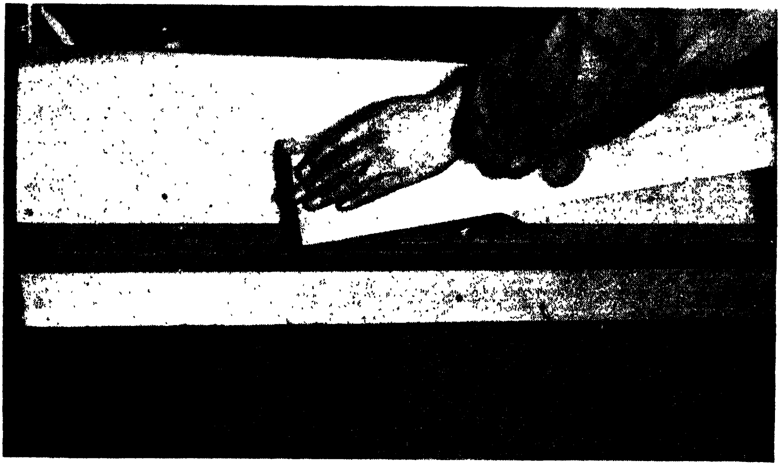

Fig. 18.—"Dropping on" for a Stopped Moulding—First Position

stroke or two on the tops almost flat. (Many people put a big angle on the tops and the saw will certainly cut better but will blunt quickly.)

The Set of the Teeth

Too much set is as bad as too little, and wastes both wood and power. The pull-over set and a gauge, or an anvil setting apparatus should be used, the setting being done with a hammer and adjustable for different diameters.

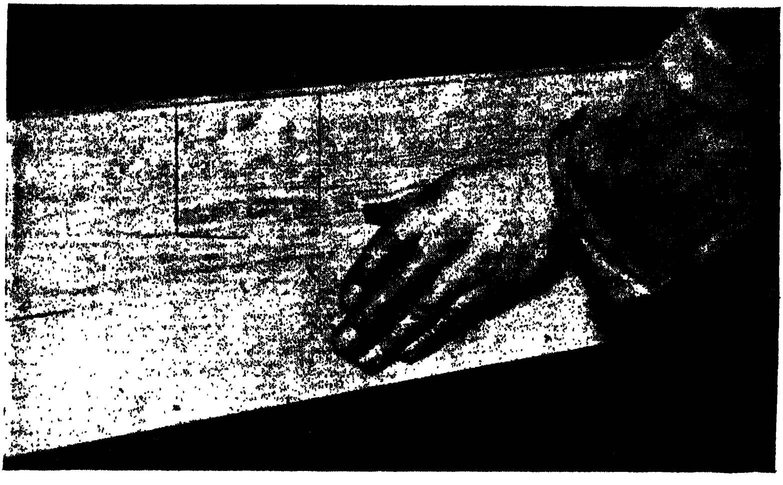

Fig. 19.—Stopped Moulding—Second Position

Ready to feed forward. Note start and stop marks on fence and wood.

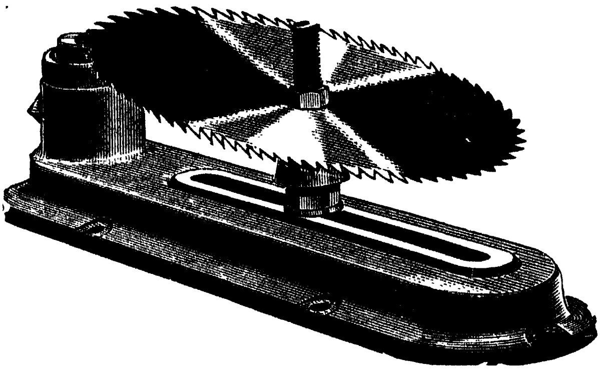

Fig. 20.—ANVIL SAW SETTING APPARATUS

of saws and amount of set, are both good—the latter for preference.

Only the tip of the tooth should be set—not the whole tooth.

Saws for soft wood require more hook (forward pitch) and more set.

Hardwood saws and cross-cut saws, less hook and less set.

Hollow ground saws no set.

Tension

Circular saws are not flat steel discs; the teeth do the work and get warm, warmer than the rest of the saw, therefore the rim expands more. To counteract this the body of the saw is hammered to 'spread' it—make it slack, leaving the rim tight; thus when the rim expands it does not become too big for the body of the saw.

This is what is meant by tensioning a saw; that is not the whole story, speed and centrifugal force are considered too.

Unless ordered otherwise saws are tensioned for a rim speed of 10,000 feet per minute. Tensioning is an expert's job.

Saws require re-tensioning occasionally and always after gulleting.

Size of Teeth

The idea that many small teeth on a rip saw will produce better work is a fallacy. Try ripping a thick board with a fine tooth panel saw, then try the same job with a rip or half-rip saw!

The dust and fibres cut by each tooth are held in the gullets until they run clear of the cut. Small teeth mean small gullets—the little teeth "bite off more than they can chew," become choked.

Repeated sharpening reduces the depth of the gullets: but that process is accelerated unnecessarily by 'topping up' instead of sharpening correctly. The filing should be done on the *fronts* of the teeth and very little off the top, file right into the gullet with the round edge of the file, this prevents cracks from developing.

Teeth may be smaller for crosscutting, dimension sawing, etc.

Too much set puts a heavy strain on the saw and is a frequent cause of cracks, we have seen saws with so much set that the two lots of teeth—right and left hand—were cutting separate tracks.

The right and left hand teeth must always partly cover each other.

After setting and sharpening a saw lay it on a flat surface and lightly pass an oil stone over the sides of the teeth to remove the high points; this will ensure a better surface and reduce the amount of planing necessary; provided the saw has been stoned frequently and all the teeth are cutting.

General Remarks

The circular saw bench is a hard-worked machine because most joinery work is first treated by it. The cleaner it cuts the easier it is for the other machines to work on its product.

Do not work the saw when you think it should be overhauled, but attend to it at once and thereby avoid trouble, and probably accidents.

Inserted Teeth Saws

These saws are not used as much as they ought to be; when first introduced from abroad they were too thick for anything but breaking down big timber, but British made ones are available several gauges thinner. They are not a practical proposition for the odd job machines using saws from 16-in. to 20-in. diameter, but there are many joiners, builders, furniture manufacturers, pattern makers and body builders, etc. who.use 30-in., 32-in. or 36-in. saws, and in a comparatively short time accumulate a number of saws too small for their deep cutting, and too thick for general use. Some will jib at the price of inserted teeth saws, but others take the long view and believe that the best is the cheapest.

Inserted teeth saws 30-in. and 32-in. diameter are 12-gauge same as plate saws of the same diameter, but if the kerf were wider, the swage setting of the inserted teeth produces a better finish requiring less planing; the finished thickness will not be less.

Teeth of high speed steel last much longer without sharpening, and take less sharpening; they are easier to feed, and take a faster feed; seldom need hammering, never gulleting or stoning, and retain their original diameter for ever.

For cutting the abrasive timbers, teak, Australian walnut, greenheart and Columbia pine (Columbia pine may not be abrasive but is bad to cut) the high speed steel teeth are a great advantage.

Swage Saws

The circular saw is admittedly the most wasteful saw; small wonder then that users frequently enquire for thinner saws. I remember a man ordering a swage saw to split some 3-in. and 4-in deals down the centre! He was supplied with a saw ground off both sides, an amount equal to the set.

Swage saws are ground from the collar to the rim, on the fence side. The gauge at tooth varies from 17 to 21. They are many gauges thicker in the centre than a standard saw, they have more and smaller teeth, and should be run at higher speeds.

Swage saws are for cutting thin slices off, ¾-in. thick being the maximum. Only an experienced sawyer should handle these saws.

Thin saws are always available, but knowing the rough treatment which many saws receive, makers and salesmen do not ‘push’ them unless they know their customer. The thinner the saw the more skill and care required to use it successfully.

CHAPTER II

CROSS-CUT SAWS

CROSS-CUTTING is an operation common to all woodworkers. If wood is used, whether for building ships, buses, houses, portable buildings, or making furniture, boxes or picture frames, it requires cutting to length.

Forgetting machines for a moment, examine any woodworker's tool kit, and however many saws there are, only one will not be for cross-cutting.

Amongst the many types of cross-cutting machines, only about four have had a moving saw with the timber stationary; and only one or two have cut in a straight line and not an arc.

Travelling Saw Head

Electric power has made possible the travelling head saw.

For cross-cutting, a saw may be run very much faster than for ripping. This fact has been of great assistance in designing these machines, as the higher speed enables a motor smaller in diameter, and lighter in weight to be used.

When selecting a machine, robust construction, with large bearing surfaces to moving parts to eliminate spring and ensure rigidity and accuracy, together with ease of operation are essential qualities.

Large works requiring several cross-cuts, will have different types and sizes, but the average medium sized shop should have a machine with compound movements to cut square, simple, and compound angles.

The machine should, if space permits, be fixed in line with the door through which the timber is brought, so that long lengths can be placed on the table without being turned.

A table on both sides of the saw will be found useful. Some machine makers supply iron stands to support the tables.

Steel gauge bars with brass rules fixed on them, and a number of sliding stops are also available for right or left hand operation, the stops having automatic action. These length gauges can be set to the different lengths required, enabling timber to be cut quickly and accurately, without any measuring, and the minimum of waste.

When a quantity of narrow stuff, matchboards, sash stuff, etc., is required, a special long stop can be used and a number of pieces cut at one stroke. Multiple trenching is also provided for, a stop shaped to drop into one trench and locate the cutting of the next being provided.

When trenches have to be stopped short of the front edge of a board, an adjustable stop can be set to limit the forward travel of the saw or cutters.

Tools

The saw for general work must be of stout gauge-12g for 16-in. diameter, 11g for 18-in. diameter, more teeth than a rip saw, the teeth having a slight negative hook. They should be sharpened with some bevel on the front and more on the top. The saws should be lightly stoned occasionally to ensure each tooth being the same distance from the centre.

For extra clean finish hollow ground dimension saws can be used.

For trenching Huther pattern multiple grooving saws are suitable, these giving a very clean finish. They can be built up in 1/16-in. to cut trenches from ⅛-in. to 2-in. wide. Several other types of trenching heads may be used.

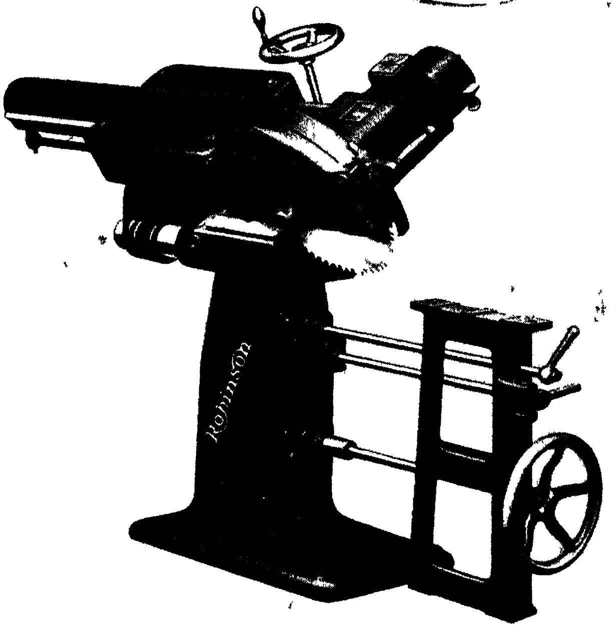

Fig. 21.—TYPE ZC/E ELECTRIC TRAVELLING HEAD CROSSCUTTING AND TRENCHING MACHINE FOR STRAIGHT AND COMPOUND ANGULAR WORK

(*Thos Robinson and Son Ltd.*)

Trenching can be done at any angle or compound angle. "Whitehill" cutter heads are used on these machines for birds mouthing, shaped trenches or grooves, and square turning.

Louvred ventilators, venetian shutters, partitioned boxes and drawers, shelving and pigeon holes can be quickly and accurately cut.

These machines are a boon on a building site for roofing, trimming floors, and many other jobs.

The Pendulum or Swing Cross-cut Saw

Cross-cutting is common to all woodworkers and the pendulum saw has several advantages for this purpose over all other cross-cutting machines. It is simple and safe to operate, occupies very little floor space, and, not least is the cheapest power machine in a woodworking plant. It is especially useful where space is limited and is often fixed outside the workshop to eliminate the inconvenience and danger of carrying long pieces of timber into the shops, amongst machines and workers.

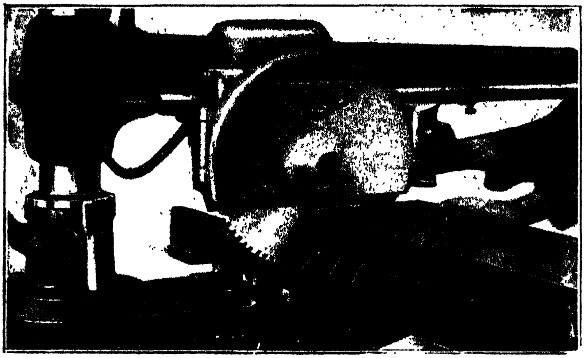

Fig. 21a.—Square Cutting 4¼ in. × 11 in.

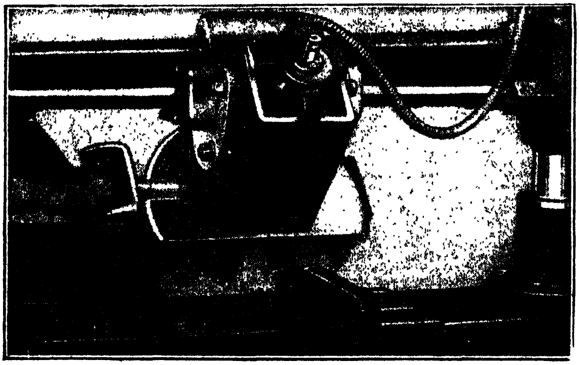

Fig. 21b.—Cutting a Flat Mitre. Head Tilts 45°

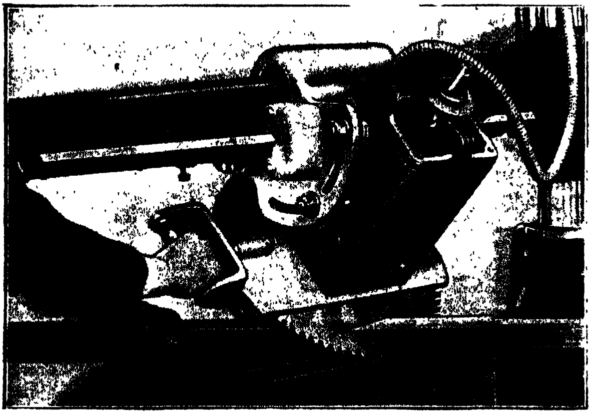

Fig. 21c.—Arm Swivelled and Head Tilted, Cutting a Compound Angle—Jack Rafters, etc.

(*Wilson Bros. Ltd.*)

Methods of Fixing

A pendulum saw can be either hung from overhead or fixed to a wall or vertical posts. When fixing to posts or stanchions, make sure that they are well braced and rigid, or the saw will not cut accurately and will probably bind in the cut and spoil the saw.

When fixing the machine to a wall there must be room for the saw to swing back clear of its work, either by packing out the hangers from the wall or cutting an opening for the saw to go into.

Making the Bench

Make a wooden bench, not too high, say 2 ft. 6 in., with a shallow fence along its back edge. A piece of 2-in. by 2-in. will do.

Making a Useful Length Gauge

It is best to run a groove along the top of the fence on one side of the saw, wide enough to allow a bolt head to slide easily. Screw a strip of iron on either side of the groove, partly covering it and thus forming a T-slot for the bolt to slide in, cast iron shoe to straddle the fence with a hole for the bolt and a wing nut, and you have a good length gauge. A piece of sheet metal with a lug twisted at right-angles or even a wooden shoe will serve.

For Heavy Timber

If heavy timber is to be cut, rollers let into the bench top at intervals along its length and just projecting slightly above the surface will ease the work enormously.

Types of Saw

The saw must, of course, go below the face of the bench, how much below depends upon the class of work to be done. The more the saw is buried in the bench the wider it will cut, but less thickness.

A joiner or builder using mostly deal should aim at cutting squarer sections. Packing-case or portable-building makers do not handle thick stuff, but will often wish to cut several boards at one time. Those handling hardwoods, such as cabinet-makers, body builders, etc., will require more width. Most pendulums carry a 24-in. diameter saw, which should cut 18-in. by 7-in. or 20-in. by 6-in., while 30-in. and 36-in. saws are occasionally used.

If angular cuts are required, allow for extra width and fix the fence so that it can be easily swivelled, the pivot being, of course, at the saw end of the fence. Most makers will supply blue prints showing relative positions of machine and bench, with details for fixing, and maximum width and thickness of cut possible.

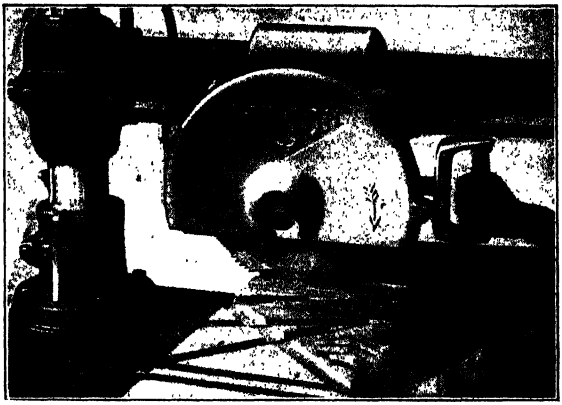

Fig. 21d.—TRENCHING; USING HUTHER PATTERN MULTIPLE GROOVING SAWS

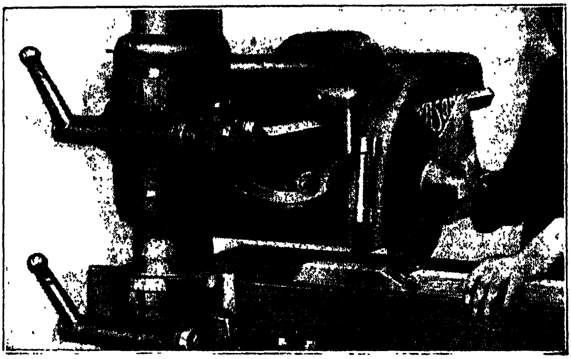

Fig. 21e.—"BIRDS MOUTHING" A RAFTER USING A WHITEHILL CUTTER HEAD. SQUARE TURNING CAN BE DONE ALSO

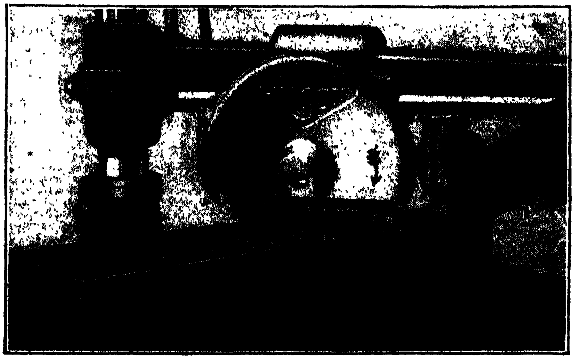

Fig. 21f.—CUTTING A MITRE

(*Wilson Bros. Ltd.*)

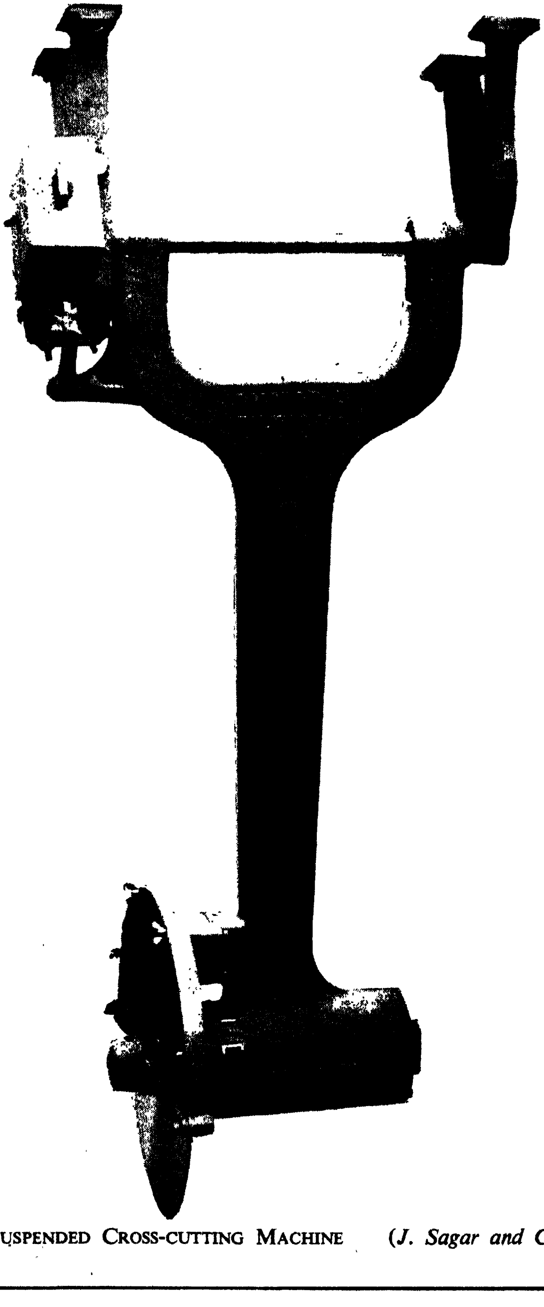

Fig. 22.—SUSPENDED CROSS-CUTTING MACHINE (*J. Sagar and Co., Ltd.*)

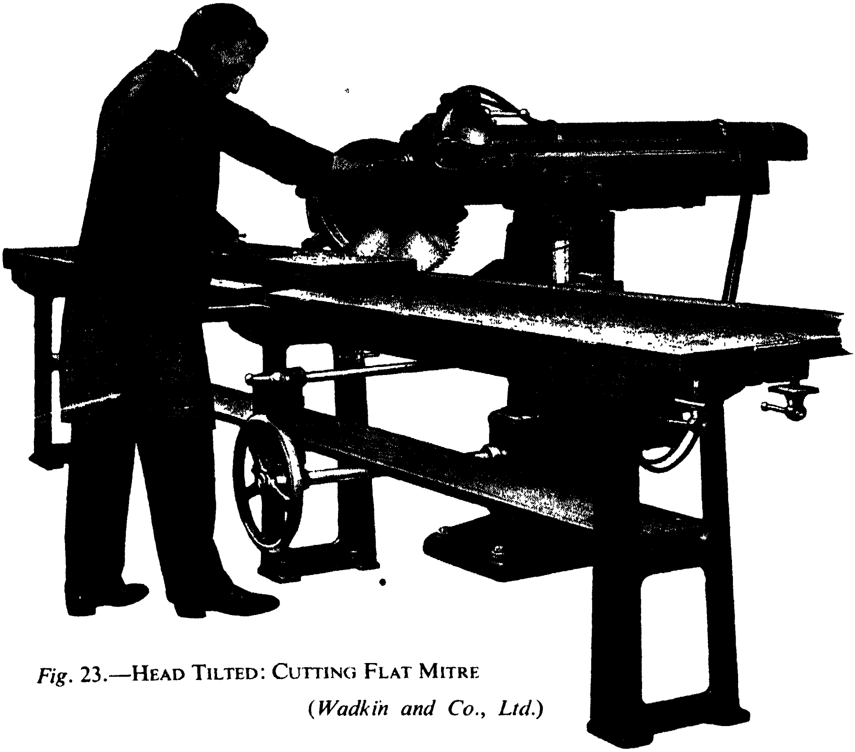

Fig. 23.—HEAD TILTED: CUTTING FLAT MITRE

(*Wadkin and Co., Ltd.*)

Improved Features

Pendulum saws have, with most other machines, been much improved in recent years: ball bearings to spindles and pulleys and, in some cases, the pendulum is pivoted on ball or roller bearings. Compensated balance, too, is fitted by all the best makers. This gradually cuts out the effect of the balance weights as the saw is brought forward and combined with the frictionless pivots makes the saw very easy to work.

Driving the Saw

Electric power has helped greatly to solve driving problems with this machine If two- or three-phase A.C. current is available, the machine should be beltless, with the motor built into the bottom end of the pendulum and the saw carried on the motor spindle. D.C. motors can be fixed in place of the countershaft in the top of the frame and the saw driven by belt direct. The latest designs have hinged guards with provision for packing the saw, which ensures greater accuracy and cleaner cutting.

Teeth of Saw

"Peg" teeth have generally been accepted as correct for cross-cutting, but they are not easy to keep sharp, and owing to their shape, they strike the timber at a back angle and prefer to slide over rather than cut, making the cutting slow and requiring more pressure.

The sharp angle in the gullets of "peg" teeth makes them very liable to develop cracks.

Sharpening Gullet Teeth

A moderate rip tooth is better for this purpose. It should have very slight hook (forward pitch) like a hardwood saw. Sharpen with small angle on the fronts of the teeth and nearly flat on the tops. The saw should be stoned down occasionally before sharpening by holding a piece of stone or old emery wheel square to it and just slightly touching the tips of the teeth as it revolves. This ensures every tooth cutting and makes a great difference both in the quality and quantity of its work. The teeth should be given moderate set and after setting it is a good thing to give a few rubs with a flat oilstone on both sides of the saw to level down any high points due to unequal setting.

CHAPTER III

SURFACE PLANERS

THIS machine has probably more names than any other woodworking machine—surface planer, jacker, facer, buzz planer (American). Whatever name we care to use, it is a most useful machine. Indeed, we suggest that it saves more hard work than does a circular saw, hand planing being harder work than hand sawing.

Jack plane, trying plane, smooth plane, badger, fillister, plough, matching planes, moulding planes, hollows and rounds, twisting laths and many other hand tools are required to do all that this machine will do.

THE MACHINE AND ITS PARTS

The fence, against which the timber is held, can be made to slope or cant, and is shown at B. The guard to the cutters is shown in Figs. 26 and 28, held either by the quick-acting clamp in Fig. 26 or screw in Fig. 29.

The ideal machine should have a circular cutter block of large diameter running in ball-bearings, cutters which give a shearing cut, long tables with both horizontal and vertical adjustment, a long fence which will cant to various angles up to 45 degrees, steel lips to the tables and facilities for rebating.

There are two tables, as shown in Fig. 25; the back, or out-feed table E, and the front, or in-feed table F, and the cutter block C in between. Each table has rise and fall movement, and may also be drawn back horizontally for access to the cutters, and to increase the width of the 'throat' to allow moulding irons to swing, if the cutter block is arranged to carry them.

Overhand planers are made in many sizes, from the small bench planers of 4-in., 6-in. and 8-in. wide up to 24-in. wide. The choice depends upon the class of work we have to do. The most popular sizes are 12-in. and 16-in. We have a further note on this question later.

Length of Tables

Long tables are very desirable, not only for jointing, but to make the work much easier. Suppose we have a 12-ft. length of 11-in. by 3-in. to plane and the two tables are each 2 ft. 6 in. long. We have 9 ft. 6 in. hanging over the end when we start cutting and again as we finish. If the tables are 3 ft. 6 in., a popular size to-day, the fatigue of handling long heavy timber, especially single-handed, is very much reduced.

Height of Tables

Height from floor to top of tables should not exceed 2 ft. 6 in. to enable one to work comfortably and to use one's weight effectively.

The Fence

The fence should be easily and quickly adjustable both across the table and to tilt to any angle to 45 degrees. A long fence is a great help.

Steel lips ensure a narrow throat or gap and reduce danger.

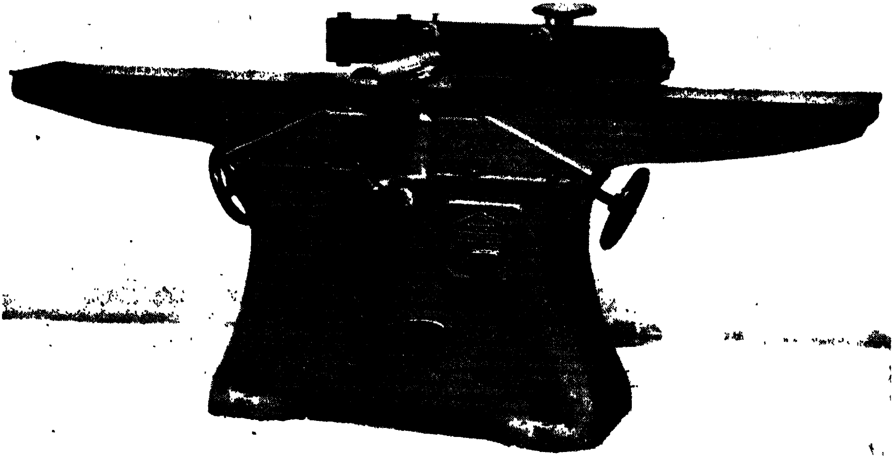

Fig. 24.—Heavy Type Hand Feed Surfacing Machine

For planing, making glue joints, planing out of wind, moulding and other operations.

(*J. Sagar and Co., Ltd.*)

Cutter Block

The cutter block has to be circular, and the cutters should have some shear, however small. By shearing cut, we mean that the cutters are not parallel with the lips of the tables, but slightly out of parallel like a skew-mouthed plane. Planers of recent design have cutter blocks larger in diameter than formerly. This increases the cutter speed and the cutters give a flatter cut. The front end of the cutter block must be flush with the table edge if we are to rebate with it. The depth of rebate possible is limited by the distance from the top of the bearing to the top of the cutting circle, another advantage which a large diameter cutter block gives.

Suitable Speed of Cutter Block

The speed at which the cutter block revolves should not be less than 4,500 revolutions per minute especially as we wish to do some moulding, and therefore cannot have more than two planing cutters.

Number of Cutters to the Block

A few surface planers are made with three and even four cutters on the block, and they give both a better finish to the work and permit a faster feed, and are certainly desirable if the machine is only used for planing. If, however, it has, like so many other machines in a joiner's shop, to do other jobs requiring extra cutters, the two-knife block is an advantage as the extra cutters can be fixed without disturbing the planing cutters.

A three-knife block is unsuitable for moulding, etc., because three cutters would have to be set up to preserve the balance. The reason for fitting more than two planing cutters in modern machines is to compensate for the lower

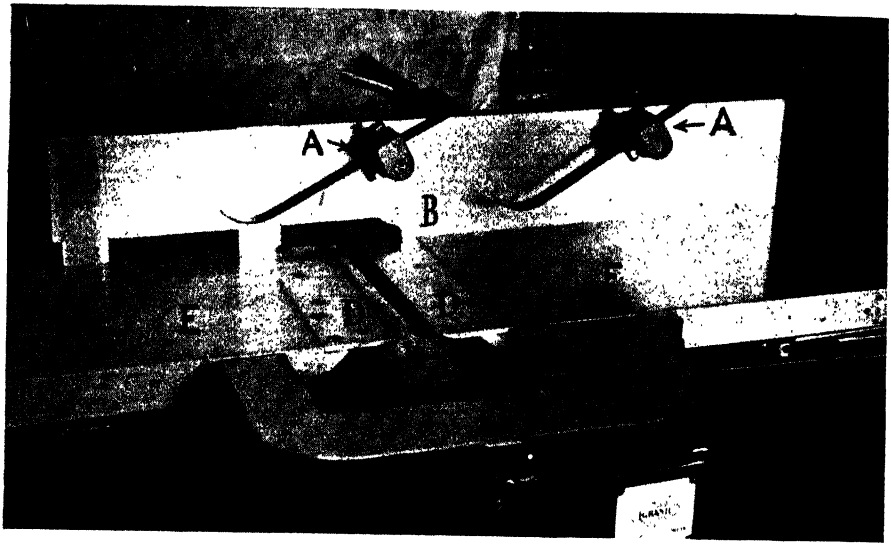

Fig. 25.—Close-up View Showing Parts of Overhand Plane

A, holding-down springs; B, fence; C, throat and cutter block; D, lip; E, back or out-feed table; F, front or in-feed table; G, rebating table.

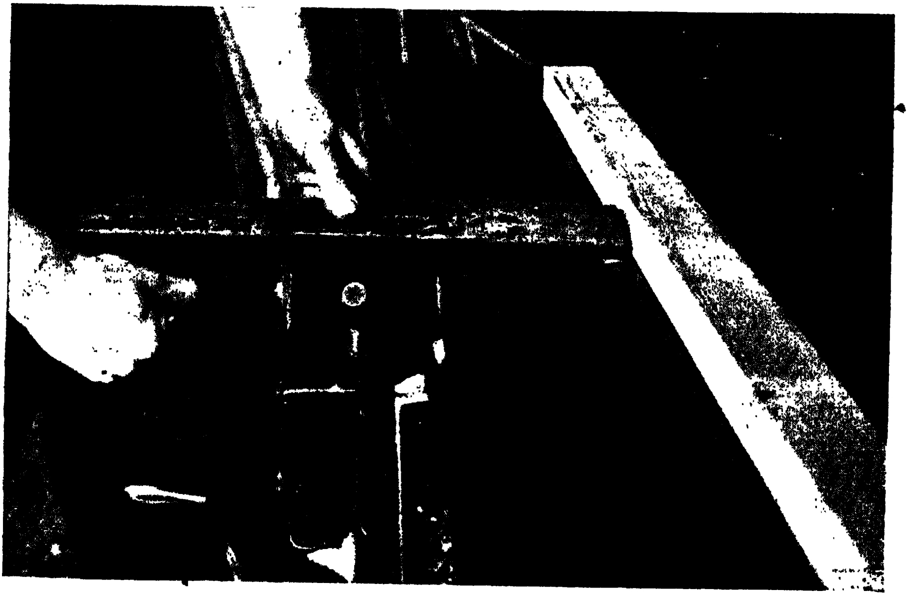

Fig. 26.—Guard Being Fitted to within ½ in. of Timber to be Planed or Moulded.

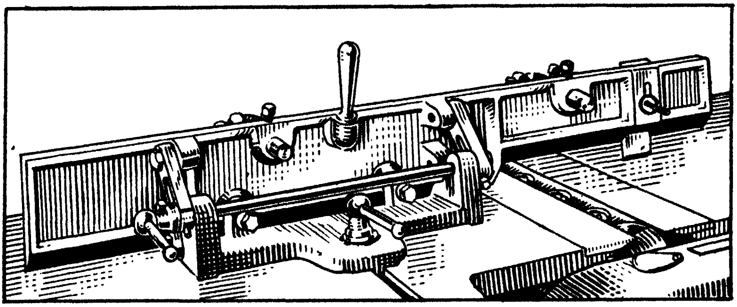

Fig. 27.—BACK VIEW OF THE CANTING FENCE OF A PLANING MACHINE

Parallel adjustment across the table is obtained by means of a spigot and a dovetail slot in the table.

speed (under 3,000 r.p.m.) imposed by the standard British electric frequency, when the machine is driven by a motor built direct on the cutter block spindle.

What Happens when Cutters are not Set Accurately

However many cutters there are, they must each be set to cut, and this requires patience and care—even with the help of the various setting devices available. Far too many men do not get even two cutters both cutting, so that the provision of more cutters would be wasted upon them. This needs emphasizing—it is not a matter of a thirty-second of an inch. If one cutter is a thousandth part of an inch farther out than the others, it will do all the work.

Fig. 28.—PLANING FLAT STUFF

Showing the correct position of the guard, i.e. extending right to the fence and only high enough to allow the wood to pass under it.

Balancing Cutter Block

The correct balancing of the cutter block and pulley is most important as it affects both the quality of the work and the life of the bearings. The absence of vibration and a constant musical note when running are reliable evidence of good balance. Methods of balance have been greatly improved in recent years, but only the few first-class makers have the necessary machines for achieving this scientifically.

The old method of static (standing) balance could not take into account centrifugal force and as this increases as the square of the speed, it is more than ever important with the modern higher speed machine that the revolving parts be dynamically balanced (running balance).

NOTES ON DRIVING

Electricity is revolutionizing methods of driving all machinery, and woodworking machine makers are not behind with new ideas.

Driving Belt

A belt drive is best for a surface planer. The very latest machines have multi vee belts from a motor installed either on the floor, or on the machine frame. This makes a very neat, compact and efficient drive. The majority, for one reason or another, are driven with a flat belt and this must be a very pliable one. Thick, stiff or heavy belts cannot get round the small pulleys on the cutter block at the necessary high speeds, effectively. If you doubt this and are running with a thick belt, experiment with a piece of upholsterers' webbing. It is worth while having the belt made endless, it is the joints that cause belting troubles.

OPERATING THE MACHINE

First close the throat to its minimum by pushing each table horizontally towards the cutter block. Most good machines are made so that they cannot be pushed into the cutters.

The front and back tables can be separately operated to varying heights in relation to the cutters.

Take care when drawing the tables back not to slacken the screws more than is

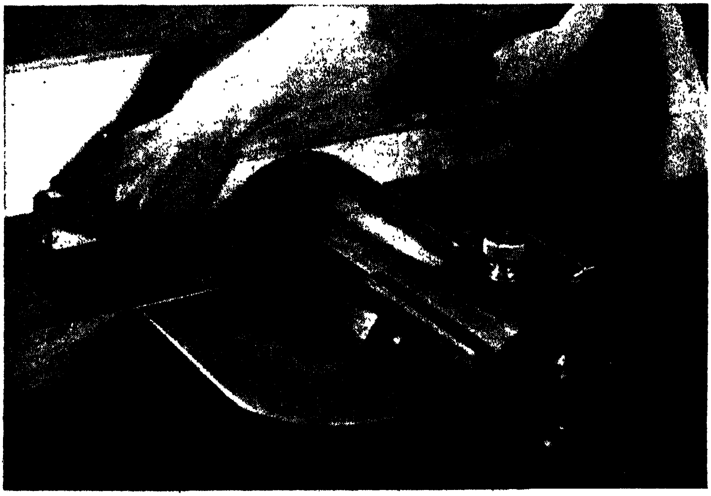

Fig. 29.—EDGING NARROW STUFF

In this case the guard covers the whole exposed portion of the cutters in front of the wood just allowing the wood to pass between the fence and the end of the guard.

Fig. 30.—OVERHAND PLANER, SHOWING MACHINIST PLANING POST

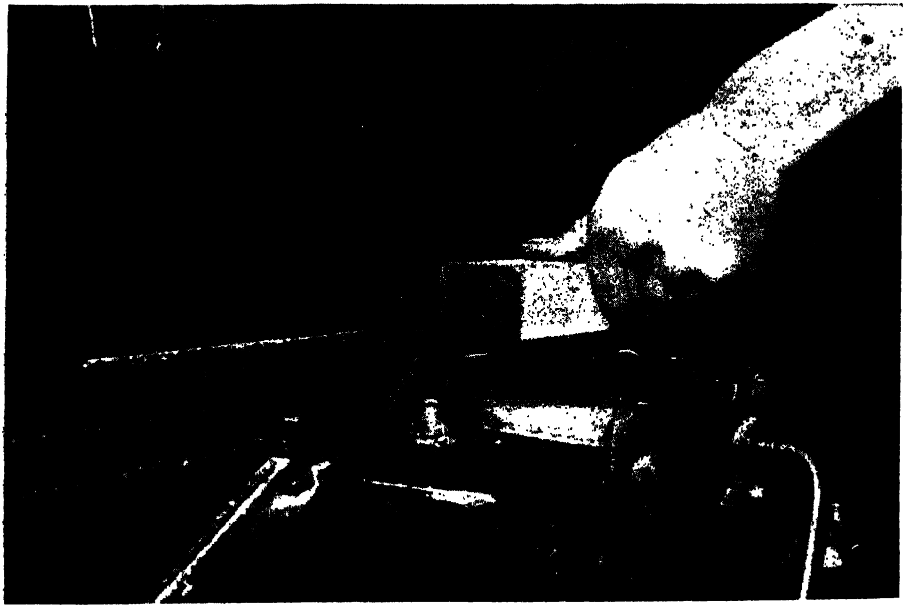

Fig. 31.—REBATING ON OVERHAND PLANER

Note the position of the fence. Move this forward to the distance of the width of rebate from the front edge of the table. Lower the front table to the required depth of the rebate.

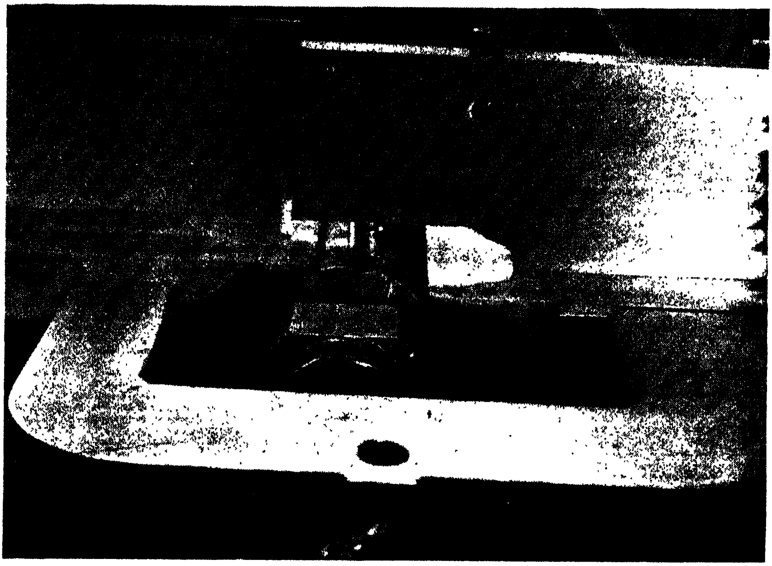

Fig. 32.—FRONT TABLE LOWERED FOR REBATING

Note that the back table is dead level with the top of the cutting circle. Difference between levels of the two tables shows how much is to be taken off.

absolutely necessary, or the other end may lift, tilting the lips into the cutters. This would result in serious damage to both tables and cutter block if the machine was running.

Setting the Back Table

The back table should not be set lower than the edge of the cutters, otherwise the planing will be uneven and it will form a gap at the end of each piece of wood which is planed. If the back table is higher than the cutters the timber will not be able to be passed over, as it will catch the lip of the front table, and stop.

Set the back table (that is the one on your left as you face the machine, the cutters invariably run clockwise) level with the top of the cutting circle so that if a short straight piece of wood is held on the back table and the cutter block revolved by hand the cutters will just touch the wood without cutting it. Lower the front table below this level for the depth of cut required. Lay the wood on the front table and having started the machine, feed over the cutters.

The Degree of Finish and How Obtained

The quality of the finish depends upon the relation between cutter speed and feed speed. Obviously, a rotary cutter does not take a continuous cut but a series of cuts. A few figures in this connection will be interesting to some readers. If the cutter block has two knives and revolves at 4,000 r.p.m., it gives 8,000 cuts per minute. Suppose we plane a 14-ft. length of timber in one minute; 14 ft. equals 168 in., divide 168 into 8,000, and we have almost 48 cuts

Fig. 33.—"DROPPING ON" FOR STOPPED CHAMFER

. Both tables lowered alike. Fence tilted 45°. Timber laid against fence and front end resting on back table beyond cutters. Beginning of chamfer over far end of cutter arc, slowly lower back end of wood on to table, keeping it against fence. Feed forward until finish of chamfer, when one end of wood is lifted clear.

per inch. If we increase the cutter block speed to 4,500 we get another 1,000 cuts per minute, and 53.5 cuts per inch—and at 10 ft. per minute, we get 75 cuts per inch.

Where Finish is Important

In joinery and cabinet work all planed timber does not need the same finish; a panel, a drawer front, a table top, or the stiles, rails, etc., of a door need planing to a fine finish, whether deal or hardwood, so that scraper and glass-paper will give the final finish.

Where Finish is not so Important

Planing either by hand or machine has another important object in view, to secure a "true" surface "out of twist." Many parts of joinery, etc., require planing "out of twist," but the finish is not important because it is not seen and may not be painted, varnished or polished; the underside of a table top must be true, to lie on and fit the frame, likewise drawer sides and backs, laminated and built-up jobs, such as engineers' patterns.

Now we have given the figures in the previous paragraph partly to show what effects the degree of finish, but we have given them more especially to emphasize the importance of making each cutter, however many there may be, cut. If only one of two cutters is working, our figures are all halved and both quality and quantity of work suffer and energy is wasted. It is like a "dud" plug in a car engine. We shall have something later to say about setting the cutters.

Planing Out of Twist

The overhand planer takes stuff out of twist. It cannot do otherwise unless the wood is so thin that we can bend it as we feed, when, of course, it will resume its natural form as soon as the pressure is relieved.

Preparing for the Thicknessing Machine

The overhand planing machine is used mostly for "trying" up work for thicknessing. This entails planing and taking "out-of-wind" the best side of the timber, which is termed the "face-side," and then after being sure that the fence on the machine is set square, the next operation is to plane the edge, which is termed the "face-edge," keeping the "face-side" firm against the fence. By doing this it will be found that the stile or whatever is planed is perfectly square, ready for the thicknessing machine.

Fig. 34.—CHAMFERS AND A TABLE LEG
Examples of work done on an overhand planer

Piece Badly in Wind

If a piece is badly twisted, lower the front table an extra turn and take a heavier cut or two and finish with a lighter cut.

Just as when trueing up with hand-plane and winding laths, take most off the thickest corner of the board so as to retain maximum thickness when finished.

While avoiding very short pieces, it is best to cut the stuff into its various required lengths before planing. They are easier to handle and do not lose so much in the trueing up process as a long piece.

Planing "out of twist" on a surface planer is one of its most valuable properties. It cannot be done on a thicknesser and the ready planed stuff purchased from the mills has usually been through a four-cutter and is not "out of twist." Both these machines have pressure feed rollers. Various attempts have been made to supply a power feed to surface planers with rollers, but have always failed because they defeated this "trueing up" quality.

In recent years the finger-feed surfacer has achieved both purposes but this machine is outside the scope of this article.

Planing the Edge

Having planed one face of each piece, we now plane one edge, holding the planed face up to the fence which can be set either square or at any other angle required to the table. As we plane, we straighten too, taking extra cuts in the

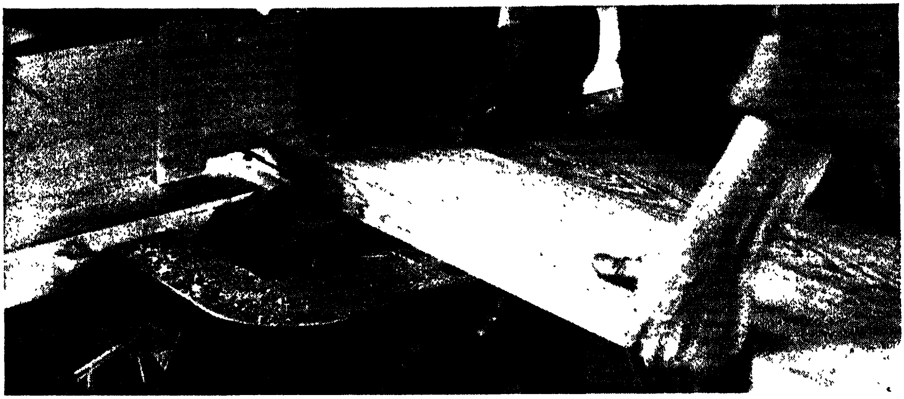

Fig. 35.—TENONING

This is done in the same way as rebating. The ends of the rails, must, however, be cut square to slide along the fence. Holding the stuff straight and steady needs great care.

centre if round, and at the ends if hollow, and finishing with a through cut (just as with a trying-plane).

Thicknessing on the Saw

If a thicknessing machine is not available the pieces can be taken to width and thickness on the saw bench and afterwards skimmed over on the planer. (When thicknessing on the saw and usually trying to retain as much thickness as possible—use a strong saw well packed.)

If a dip is produced at the finishing end of a piece when planed, the back table has been set too low, causing the wood to drop as it leaves the front table. The back table should be set to receive the wood exactly on its new face formed by the cutters.

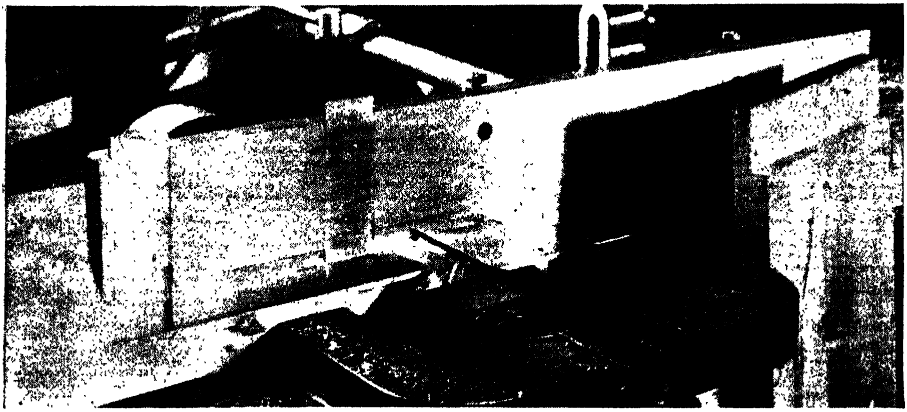

Fig. 36.—SHOWS THE TENON

Also position of table and rebating table.

The Guard

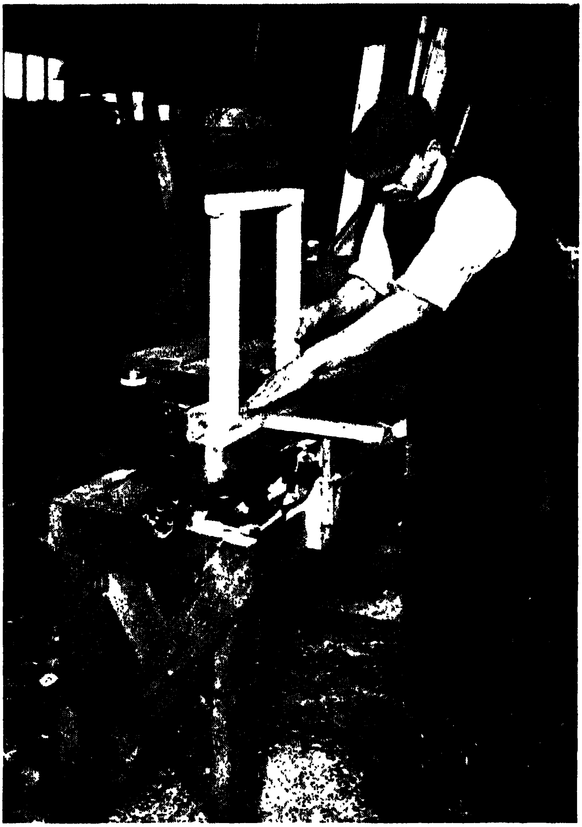

Fig. 37.—MINIATURE OVERHAND PLANER, USED BY BENCH HANDS WHEN FITTING

Being operated in planing the underside of the bottom rail of a sash.

All overhand planers in Great Britain must be fitted with a bridge guard made of metal and adjustable to cover as much of the cutter block as the job will allow. The modern machine with circular cutter block, and small throat due to steel lips on the tables, is not a dangerous machine, correct use of the guard makes it perfectly safe. When planing flat stuff, the guard should extend right to the fence and only high enough to allow the wood to pass under it, the hands being kept on the top of the wood, one on each side of the guard. When planing edges, especially of narrow stuff, it is easy to get the finger-tips on to the cutters when holding the wood to the fence, the guard should, therefore, cover the whole exposed portion of the cutters in front of the wood—just allowing the wood to pass between the fence and the end of the guard (see Figs. 28 and 29)

The machinist should keep the bolts and nuts together for the guards and templates required for the various work. It is a good plan to have a box with divisions for cutters, bolts and spanners ready on or near the machine. Fig. 26 shows the guard being fitted to within ½-in. of the wood to be planed or moulded.

Glue Joints

When making glue joints straight from the machine, go slower on the finishing cut, so that a very smooth surface is obtained. This sort of work will come to the operator as he gains experience. When jointing two pieces of boarding together for shelving, etc., the first thing to do is to pick out the best sides of the boards, mark them with the "face-side" marks, shoot one piece with face mark toward the fence of the machine, the other piece with the face mark looking to-

Fig. 38.—MAKING ORNAMENTAL BALUSTERS—"DROPPING ON" AT THE START
The balusters are produced by tapering from the centres to each side.

ward you. By this method the work will be true on the face without much trouble.

Jointing

To make joints, set the back table carefully "dead with the cutting circle" and take a light cut, holding the wood well down on the back table. By tilting the fence, joints can be made at various angles. This is useful when casing around pillars, making pillasters, wood mantels, etc.

Chamfering

This is done by tilting the fence the full 45 degrees and lowering the front table the required depth.

To make stopped chamfers, lower both tables equally, lay the timber against the fence with the front end resting on the back table beyond the cutters, and the back end held up clear with the right hand—see that the mark denoting the beginning of the chamfer is over the far end of the cutter arc, slowly lower the back end on to the table—keeping the face of the timber on the fence all the time. Hold the timber firmly so that it is not thrown back as it touches the cutters, especially if the cut is a heavy one and the wood is hard. Feed forward, going very slowly as you approach the other end of the chamfer because the cut is against the grain, now lift one end clear, whichever end is most convenient. If the fence is not long enough or deep enough to do this job comfortably—screw a board to the iron fence.

Rebating

Even if you possess a spindle moulder, there are often times when a few pieces, perhaps just an odd door casing, are required in a hurry. The planer is

Fig. 39.—MAKING ORNAMENTAL BALUSTERS—NEARING THE END OF THE CUT

With front table lowered to depth of taper, the wood is fed forward, its back end being kept on front table, until end of cut.

ready—just set the fence back from the table edge the width of the required rebate and lower the front table to the depth and in a few minutes you have clean rebates. To do this the end of the cutter block must be flush with the edge of the back table and the cutters should project about 1/32-in. and have their ends backed off slightly. Most surface planers will rebate ½-in. deep—some ¾-in. and, of course, any reasonable width.

A rebate can also be made across the grain, but for this, and also with certain cross-grained timbers lengthwise, it is advisable to run a cutting gauge on the flat way to prevent splintering. Panel raising can be done by this method. Tenons can be cut but narrow rails require some help to keep them straight and steady as they are fed across the cutters and the ends must be cut square to slide along the fence. The quickest method of tenoning narrow rails is to put a light cramp across a number of them; they can then be run across the cutters like a wide board. Sills can have one or more rebates planed on them if they are first bevelled on saw bench. (The slight undercut is not a serious matter—especially if they have to be throated.)

Stopped Rebates

These are done in a similar way to stopped chamfers, but as the cut is generally heavier than when chamfering extra care is necessary when "dropping on" at the start. It is appropriate here to say a word about the width of the planer. At first thought you might think a 12-in. machine wide enough for your work. In actual practice one finds the chamfering and rebating so very handy, and this and jointing, edging and the planing of most small stuff is all done towards the front edge of the machine, because it is easier than stretching over to the back of the tables. The front ends of the cutters therefore get used more and when wide boards are to be planed, half of each cutter is blunt and half sharp, whereas—if the machine is 16 in.—there is still sufficient length of sharp cutter to plane it.

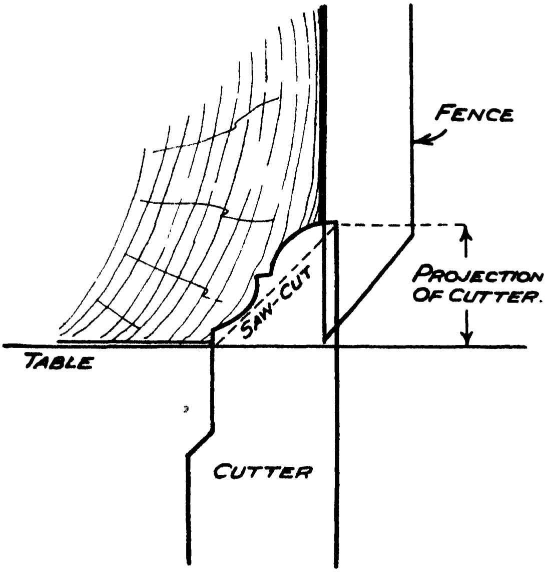

Fig. 40.—MOULDING ON THE OVERHAND PLANER

A mould worked in the way shown above involves a long projection of the cutter and therefore a big gap for it to swing. A much better way is shown in Fig. 41.

Taper Planing

Quite a variety of useful and ornamental work can be done on the overhand planer by manipulating the two tables and the canting fence. Suppose some tapered legs are required for a light table; lower the front table equal to the amount of taper, keeping the back table in neutral position level with the cutters. Place the leg against the fence with its top end resting on the back table, and the beginning of the taper over the back end of the cutter arc. Slowly lower the bottom end of the leg on to the front table and feed forward to the end, or where you require the taper to stop if you wish to leave a "foot" at the bottom. Perhaps only the outer sides are to be tapered and the inner ones left straight.

If a hollow or scallop is required at the top, lower the back table to the depth required and "drop on" and proceed as before. Ornamental balusters can be quickly and cheaply produced by tapering from the centre to each end either square section stuff or flat stuff 4 in. by 1 in., 3 in. by ½ in., etc. Having tapered four sides, tilt the fence the full 45 degrees and taper again, taking the four corners off and producing tapered octagonal legs or balusters.

Moulding

So far we have only described the various things which can be done using the planing cutters. If the cutter block is also arranged to carry extra cutters, and the two tables will draw back (away from the cutter block) horizontally, a great variety of moulding can be done, tonguing and grooving, and square turning. An up-to-date circular cutter block has loose caps fitted on opposite sides and if these are removed by taking the nuts off the bolts—flat places with either dovetailed slots or tapped holes are revealed. This enables moulding and other cutters to be fixed without disturbing the planing cutters, which can be used at the same time if the moulding cutters are so adjusted. The cutters should be of iron about ⅜-in. thick with steel faces at one end and slots for the bolts at the other.

Setting Cutters for Moulding

To set the cutters to mould stuff that is already planed, raise both tables just above the planing cutters and, having pencilled the shape of the mould on the end of one of the pieces, lay it on the front table against the fence. Put one of the cutters on the bolt with a double thickness of brown paper between the cutter and block at the back end, put nut and washer on bolt and screw up finger-tight. Revolve the cutter block by hand and set the cutter so that its longest point reaches the corresponding mark on the end of the wood, and tighten the nut with the spanner. Set the other cutter, it is always best to use pairs of cutters to preserve the balance of the block, on the opposite side of the block in the same way. Close the tables in, so that there is just room for the cutters to clear and do not forget to fasten the tables and the fence, and adjust the guard.

Start the machine and cut a few inches. If correct, finish the piece, and then stop the machine. Lay the piece you have just worked in position over the cutters and turning the block by hand, see if both cutters touch the wood exactly; it makes *such* a difference if both are cutting.

Planing and Moulding in One Operation

If you wish to plane and mould in one operation, first set the tables as for planing and then set the moulding cutters as before. We repeat, it is always best to use pairs of cutters, but provided both cutters are the same weight and the mould is not a wide one, a piece of sash stuff, for instance, a moulding cutter can be used on one side and a rebating cutter on the other, but this is not a *perfect* balance.

Mouldings where Whole Face is Removed

Nosings, picture rails and all mouldings where the whole face of the wood is removed must have the tables set as for planing, i.e., the back table a little higher than the front table to receive the mould on its new face. Owing to the cutter striking the wood at an angle the profile of the cutter is not the exact shape of the mould, when ordering cutters this should be allowed for —the exact shape of the cutter can, of course, be found by geometrical projection to the required angle, but this degree of accuracy is seldom

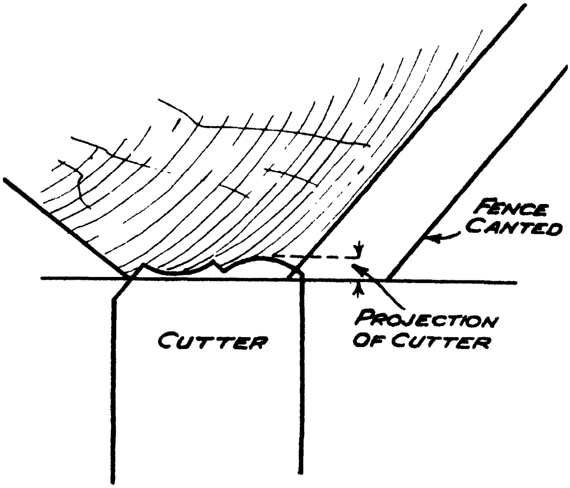

Fig. 41.—HOW TO WORK A MOULD ON THE OVERHAND PLANER

By sawing the corner off the timber and canting the fence, the mould is worked cleaner, with more safety, and in less time.

necessary. An allowance of about $\frac{1}{16}$ in. in every ½ in. depth of cut is near enough This is not merely a matter of spoiling the shape of the mould. When a mould is machined on framing and the depth of the mould forms the shoulder line, if no allowance has been made all the tenoned members will be too long or the shape of the mould be spoilt, a serious matter in hardwood, especially if the mould is a big one. Always try and work so that the cutters run in the angle formed by the fence with the table—it is, of course, correct practice because the "face" and "edge" of the wood will be to table and fence, but it is safer because the wood is always covering the cutters.

Rebating and Moulding

When rebating and moulding at the same time, or when using rebating cutters to form a tongue on the edge of boards, the cutters have to be on the outside away from the fence—so as to ensure the tongue being even thickness. Keep the projection of the cutters from the block as short as possible, for instance, if a big mould has to be struck—say 1¼ in. each way from the corner of the timber and at first sight requires cutters projecting a full 1¼ in. from the block, also the tables would have to be pulled back to allow the cutters to revolve, making a big gap between. If the corner is first sawn off—say 1 in. each way or planed off like a chamfer and then by canting the planer fence and running the piece on the chamfered face the cutters will only need to project ⅜ in. or less—they will have less work to do, be stronger, and the smaller gap necessary will be safer.

This cutter, too, will keep sharp longer because none of the cutting edge is parallel with the sides of the cutter. Nosing or beading cutters always get blunt at the sides because they are in contact with the wood longer.

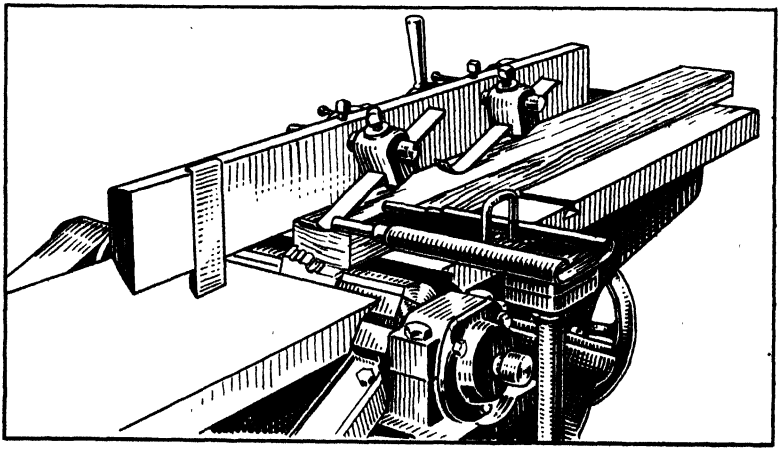

Fig. 42.—HOW MOULDING IRONS ARE USED ON CUTTER BLOCK

The cutter block is arranged to take the moulding irons without upsetting the planing knives. Holding-down springs are a great help in moulding.

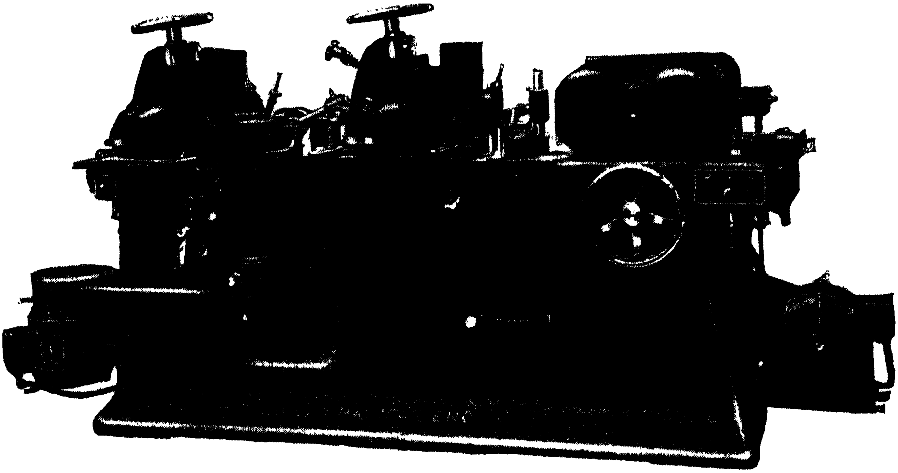

Fig. 42A.—FOUR CUTTER MOULDING AND PLANING MACHINE

This is a machine which planes all four sides of the timber at one operation, or in place of straight planing on all sides, one or more sides can be moulded, rebated, bevelled, etc. at the same operation. Additional heads are sometimes fitted such as an extra top head, beading head or throating head. In the case of the extra top head, this has usually got to be bought originally in this form, but on most machines the beading and throating heads can be added afterwards. Machines vary in sizes taking material 2 in. by 2 in. up to 15 in. by 6 in. and even special sizes outside this range have been built.

(*J. Sagar and Co., Ltd.*)

Cutting an Elaborate Moulding

If an elaborate mould with many members is required, it is not always advisable to get a pair of cutters to do it all, such cutters are difficult to grind and sharpen, and it is often better to combine several pairs of simple cutters.

Tonguing, Grooving and Moulding in One Operation

Tonguing and grooving cutters are used like moulding cutters, and if set carefully in relation to the planing cutters, the joints can be made and the tongue or groove put on in one operation.

MAKING EVERY CUTTER CUT

This is known as "jointing" the cutters and a few special machines are supplied with a mechanical device for doing it, but its cost has, so far, excluded its general adoption in this country.

The following method of attaining the same effect is well worth trying. Having set the cutters as accurately as possible with the aid of whatever device or gauges are supplied with your planer—and I may say here that experienced machinists still prefer a piece of wood about a foot long and 1 in. thick, held on the back table over the cutter block. Raise both tables until they are just above the top of the cutting circle, set the fence right back or remove it altogether

Set the machine in motion. Take a straight oilstone and holding it with both hands on the two tables lengthwise across the throat, slowly move it the whole length of the cutter block. Now, lower the back table a *fraction* of a turn and take another stroke with the oilstone. Repeat this operation (taking care to lower the table very little each time and not moving the front table at all) until a few sparks appear as you go across.

Stop the machine and examine the cutters. The parts where they have *touched* the oilstone will be bright and if both cutters have been *touched* (we say "touched" advisedly, for they should not be set so carelessly that it is necessary to more than just touch them), sharpen them in the usual way with a fine oilstone. Restore the tables to planing position and try the machine; the superior finish of the work will amply repay for the trouble taken. This operation should only be done when a fresh pair of cutters have been put in the block.

It is only necessary to remove the cutters for grinding. They can usually be honed in position.

CHAPTER IV

MORTISING MACHINES

Selecting Your Machine

THERE are three standard types: The Double Slide machine with chain and chisel side by side, Fig. 43; the Single Slide for chain mortising, Fig. 48, with hollow chisel attachment, Fig. 51; and the machine for Hollow Chisel only, Fig. 47.

Some makers offer all these types, with equal capacity for size of timber, 12 in. deep × 9 in. wide, and also capable of making the same sizes of mortise, i.e., up to 1$\frac{1}{4}$ in. with chains and up to 1 in. with hollow chisels. The class of work undertaken and space available are deciding factors.

For those without experience of these tools, a few essential facts may be helpful: Chains are available in widths from $\frac{3}{16}$ in. to 1$\frac{1}{4}$ in. rising in $\frac{1}{16}$ths to $\frac{5}{8}$ in., then in $\frac{1}{8}$ ins. to 1$\frac{1}{4}$ in. The shortest length of mortise is $\frac{3}{4}$ in., the longest 3 in. at one stroke, but 2$\frac{1}{2}$ in. is the widest guide bar stocked. Chains are quicker and more suitable for deep through mortises and hardwood.

Hollow chisels from $\frac{1}{4}$ in. square rising in $\frac{1}{16}$ths. to 1 in. square. (Larger chisels are only suitable for power-fed machines). In a small shop where expense has to be considered, it is best to have chain sets for the sizes mostly used, and chisels for odd sizes less frequently required.

For joiners' work both tools are desirable.

Furniture trades will probably find hollow chisels adequate for their work as they use smaller sections of timber, with blind mortises.

Motor body builders require both tools, the hollow chisel unit is very handy for boring for bolts and screws, and the double slide machine offers advantages in this class of work.

The double slide machine will mortise two sizes of hole in the same piece, or mortise and bore the same piece in one operation.

The double slide machine is also better for very heavy work, the table is usually longer, and with very hard wood a boring bit can be used first to ease the work of the chain; a bit with a brad point is best, the speed being high, a screw nose would snatch and probably run, especially the larger sizes of bits. An adapter is needed to carry boring bits in the hollow chisel spindle. The adaptor should be a running fit in the chisel socket, shorter bits can thus be used. Any machine only gives the output of one operator, the two single machines can be bought for the price of the double one.

Care and Use of Chain Cutting Gear

Mortise chains are a fine product of science and engineering, and deserve and repay careful treatment. Keep them *sharp*, keep in *oil*, adjust correctly, and do ***not*** force the feed.

With a new machine the chains will be sharp and greasy so we will take adjustment first. Make sure the machine is running in the right direction,

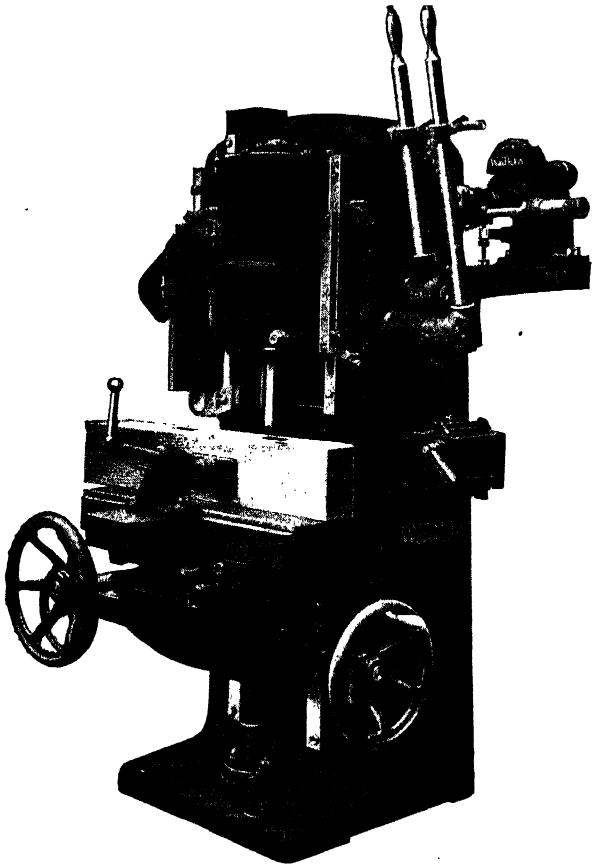

Fig. 43.—Double Slide Machine with Motor on Each Slide Chain Grinder on the Machine.

(*Wadkin Ltd.*)

if the pressure pad is on the right, the spindle must revolve anti-clockwise, and vice versa.

Select the correct bar and sprocket for the chain you wish to use, place the sprocket on the spindle with the keyway on the key provided, put the chain and guide bar on, with the chain slack.

Run the chain for a few seconds. With finger and thumb take hold of the chain and draw it away from the guide bar. If correctly adjusted it should leave the bar ¼ in.

Feed the chain as you feel it is cutting, do not choke it.

If one stroke does not make the mortise long enough, take another stroke, *do not* traverse the table with the chain in the wood. When taking a second stroke, take it on the down side of the chain, It will then be cutting partly with the grain and will cut better.

The guide bars are designed to take pressure *only* on the semicircle at the bottom where the roller bearing is (see Fig. 50). The table may be traversed to cut the groove for the haunching adjoining a tenon, as this is usually not more than ½-in. deep.

Keep the Chains Sharp

If a chain sharpening machine is not purchased your machine maker will sharpen the chains for you. (In which case duplicate the chains you use most so that you will not, when busy, work them in a blunt condition, because you cannot spare them.) Chains should not always need grinding, they can be sharpened with a good oilstone slip. Sharpen inside the gullets, never outside, taking care to preserve the original shape and angle of the teeth.

When not in use keep the chains and the working end of the guide bars in a good, thin machine oil.

Fix some pegs above the bath to hang the chains on, to drain off surplus oil before use. On a long run, drop or squirt some oil on the chain while running. Some of this will work into the guide bar bearings. Frequent sharpening and regular oil baths will double the life of the chains.

Broken chains are usually dry, and blunt beyond description.

Do not attempt to repair a broken chain unless you have the proper tools. If a new link is put into an old chain—it should be ground down to match the old ones or its bigger bites will probably cause another break.

Guide bar bearings are renewable, and should be examined occasionally.

HOLLOW CHISELS AND AUGERS

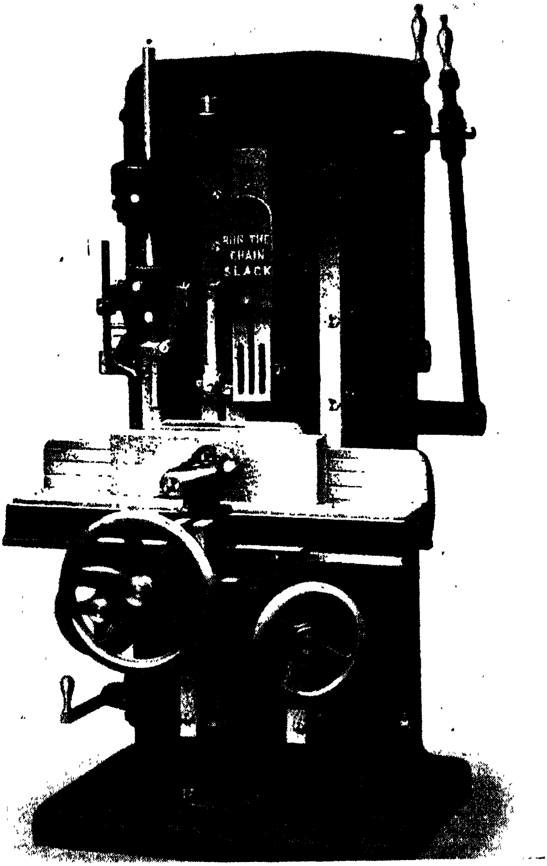

Fig. 44.—ALL-ELECTRIC CHAIN CUTTER AND HOLLOW CHISEL MORTISING AND BORING MACHINE
(*J. Sagar and Co. Ltd.*)

Hollow chisels are an older tool than mortise chains. When chains were first introduced, the shortest hole possible was 1½ in., too long for sash bars or light framing.

One enterprising firm promptly fitted a hollow chisel attachment to their chain mortiser. Shorter pitch chains will now make holes ¾-in. long, but chisels remain. Both tools should be available.

Chisels may be more popular in some quarters, partly because their initial cost is less, not a true estimate of value, for chains are much quicker, especially on heavy work. Chains properly sharpened and cared for, are probably cheaper in the long run.

The auger (or bit)

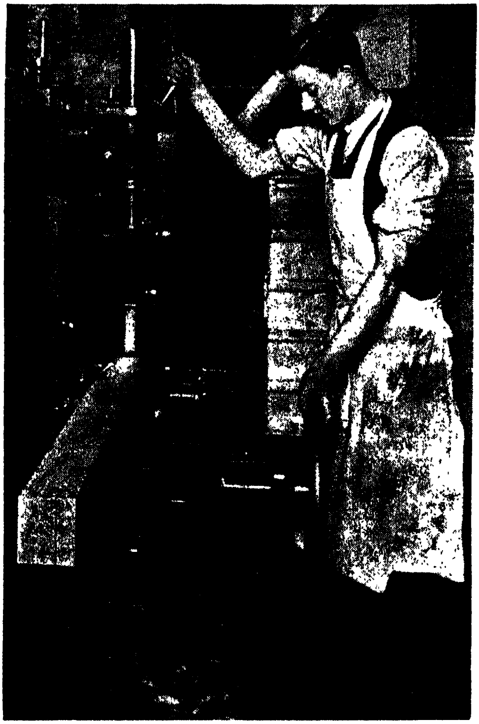

Fig. 45.—OPERATOR AT WORK ON MORTISING MACHINE

Employing the Hollow Square Chisel.

does most of the work, the chisel only squares the round hole, the operator with the hand lever carrying out the latter process.

In redwood a ¾-in. chisel is easy, but try an 1-in. chisel in English oak or birch; 1-in. chisels *are* used in these timbers.

Press an 1-in. chisel into some wood and examine the impression; it will be seen that the chisel has four corners totalling 2 in. to cut, half of it across the grain.

In hard wood, or any wood with the larger chisels, it is best to revert to the hand mortiser method; start in the centre of the mortise, the first stroke may not go far in. Withdraw and move the table half the width of the chisel and take another stroke. Only two corners are being cut this time and the chisel will probably go more than twice as deep, repeat the procedure and full depth will be achieved in another stroke or two.

Do not take less than half the chisel width, or the chisel might run sideways and be strained, especially the smaller chisels.

In some shops chisel mortality is high, due to inexperience or carelessness, for hollow chisels are fine efficient tools.

A post mortem on a damaged chisel seldom fails to reveal the cause. Here are five causes of failure with suggested "evasive action":

1. No clearance between chisel mouth and auger nose: heat is generated, cracks and splits develop.

The augers must always have from $\frac{1}{32}$ in. to $\frac{1}{16}$ in. clearance according to the size of chisel. Sometimes when this precaution has been taken, the set screw has allowed the augur to slip up. Less frequently the chisel has dropped, perhaps stuck in the wood and been pulled down.

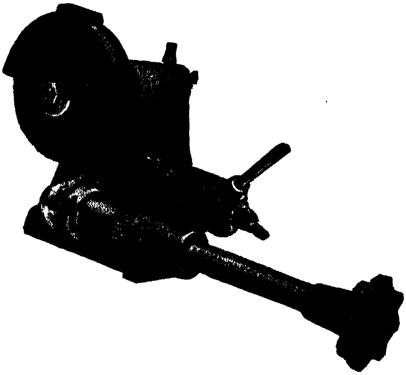

Fig. 46.—RENOLD CHAIN GRINDER

(*Renold and Coventry Chain Co. Ltd.*)

When fitting a new auger, fix chisel first (window to side), making sure that the shoulder is right up to the socket. Push auger up as far as it will go, measure accurately how much auger protrudes from chisel mouth and cut that amount *less* clearance from auger shank. File a flat for set screw to get a grip. This also prevents the bruise made by the screw hindering withdrawal of the auger.

An old machine with plain bearings may develop "play" or "slogger" in the spindle, allowing it to lift when pressure is put on the auger, so cancelling the clearance that has been allowed.

2. Working with a worn-out auger: The side cutters on a new auger extend fully the width of the chisel. Repeated sharpening reduces the diameter of the cutters, the chips are not cut small enough to pass easily up the spiral of the bit, their ejection is hindered, putting additional strain on the chisel and probably bursting it. Discard badly worn bits. Chisels cost more than several augers.

3. Blunt chisels and bits, and what is equally bad,

4. Incorrect sharpening.

Sharpen the spurs of the augers with smooth files. Side cutters on the inside, the flat cutters on the *top*.

Sharpen the chisels *inside* with smooth files, preserving the original bevels and curves of a new chisel. Do *not* make longer bevels or the corners thinner

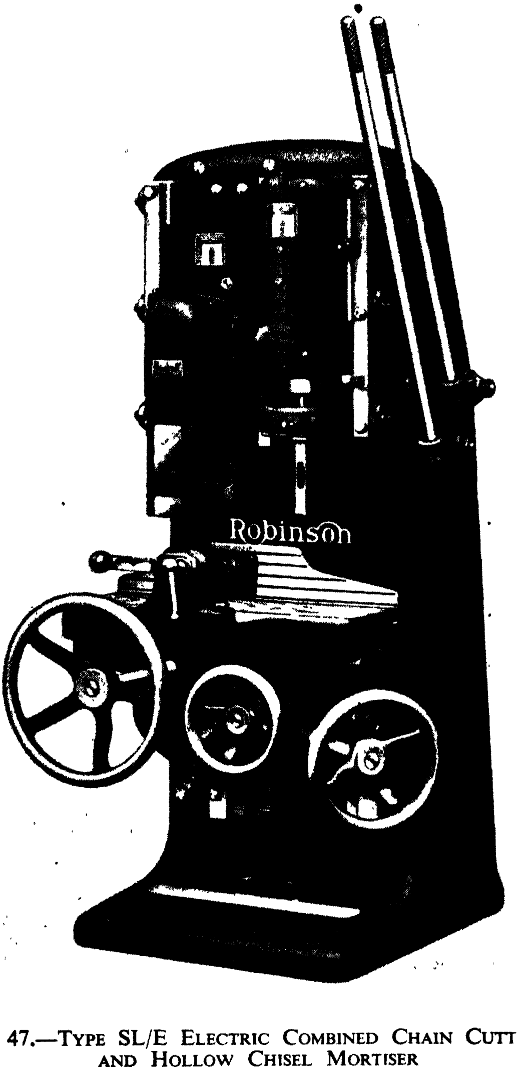

Fig. 47.—Type SL/E Electric Combined Chain Cutter and Hollow Chisel Mortiser

(*Thos. Robinson and Son Ltd.*)

than the sides, they will only burst. Do *not* make the sides "V" shape, but curved. Sharp corners in metal start cracks.

The Countersinking Tool is strongly recommended, as it saves a lot of filing and maintains the correct shape. These tools are intended to be used in a joiner's brace the chisel being held in a vice. The corners have to be finished with a file.

5. Bent chisels are sometimes caused by the chisel sticking in the wood often with the first stroke in soft wood. When the lever is raised the wood also lifts and if it happens to be the end mortise in a long piece, the downward drag of the overhanging end bends the chisel. An efficient cramp reduces this danger. Some machines have adjustable hooks fitted at the back of the table to prevent this, Fig. 47.

The smaller chisels and augers require more care. One maker supplies augers with solid centres (Irwin pattern), for chisels up to ½-in. These bits are stronger and the single twist allows more space for the chips to escape.

The "windows" in the chisel sides are intended to assist the ejection of the chips. They should be to the side and not to the front or back, so that after the first stroke, the chips can escape into the mortise; otherwise they would be covered most of the time.

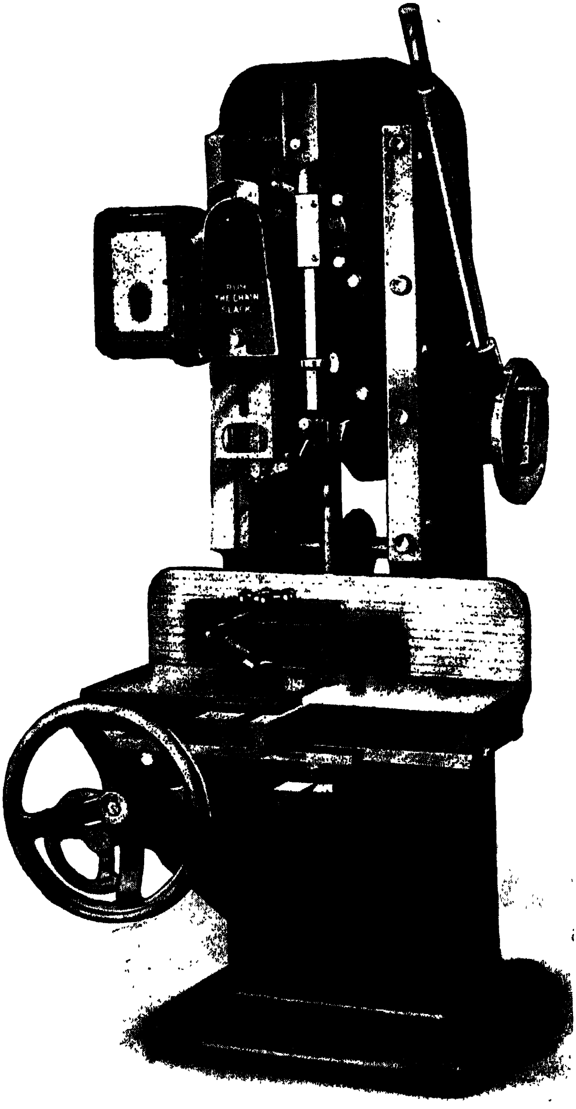

Fig. 48.—SINGLE SLIDE MOTORISED CHAIN MORTISER WITH HOLLOW CHISEL ATTACHMENT

(*Wilson Bros. Ltd.*)

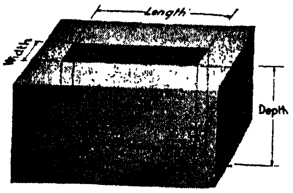

Fig. 49.

Fig. 49.—Showing how Mortise dimensions are specified

(*Renold and Coventry Chain Co., Ltd.*)

Fig. 50.—Mortise Chain

(*Renold and Coventry Chain Co., Ltd.*)

Fig. 51.—Hollow Chisel Attachment

(*Wilson Bros. Ltd.*)

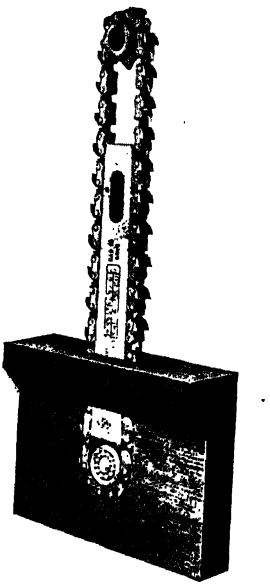

Fig. 50

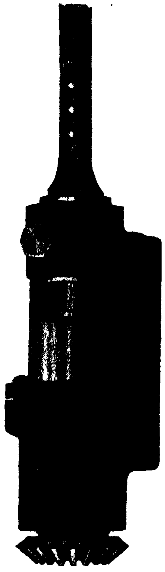

Fig. 51

It is essential that the revolutions of the augers are maintained. Motorised machines are not likely to give trouble in this respect, unless the bit is blunt, or is jamming with sticky chips. A slack belt may allow the revs. to drop.

Some makers will supply automatic setting-out attachments to their machines. These can be set to locate the positions of the mortises, and also their respective lengths.

CHAPTER V

VERTICAL SPINDLE MOULDERS

THE vertical spindle moulding and shaping machine, generally spoken of as a spindle moulder, is undoubtedly the most versatile machine there is. Even the professional spindle hand, who has worked this machine a lifetime, is still discovering and learning something new of its capabilities, or improving on his method of working it. There are nearly always two ways, often both right, of doing the same job. The purpose of this book is to give general principles to help those with little or no experience to use the machine safely to the best advantage.

At the outset, a word to those who say a spindle moulder is a dangerous machine. It is and so are most machines. People have been known to lose fingers in the homely mangle. Frankly, there are some dangerous jobs done on spindle moulders, but nearly all accidents are due to either "familiarity breeding contempt" or the operator being in too big a hurry to take the necessary and practical precautions, preferring to "risk it."

The Modern Machine

The modern spindle moulder of improved design, handier adjustments and higher speeds, is much safer than the machines of twenty years ago.

Higher speeds are safer. At 8,000 r.p.m. it cuts, where at 3,000 r.p.m. it snatches.

The machine itself is not merely a spindle and pulley, two bearings, a frame, table and fence and a few etceteras. The last fifteen to twenty years spindle moulders have been improved in every detail. The best machines now have the spindle and pulley made integral from a steel forging. The loose top spindles are stronger and are secured in the main spindle in such a way as to ensure them being true, not, as formerly, with a set screw or cotter. The table is the correct height, controls and adjustments are all quick and accessible, but the two things which have done more to make possible the modern machine are ball bearings and improved methods of balancing.

The Square Cutter Block

There are several methods of carrying the cutters on a spindle moulder.

The square cutter block is usually about 3 in. square and from 2 in. to 6 in. long, planed true and bored to fit the spindle. Each of its four faces has a dovetailed slot (sometimes a T slot)—lengthwise, with bolts, nuts and washers to fit. These and all other parts of the machine which revolve must be perfectly balanced.

Cutters for Square Block

The cutters are iron with steel face about 1½ in. long at one end, and a slot to fit the bolt at the back end, they should be ⅜ in. thick.

The square block is most suitable for heavy work and for this reason is more used by joiners than cabinet makers. It has several distinct advantages over other cutter holders.

Fixing the Cutters

For a mould with many members several pairs of cutters can be fixed on different parts of its four faces, Fig. 55, and the whole job done at one handling. This enables simple cutters to be used in combination and reduces the work of each cutter. If a cutter is not exactly the right shape, it can be tilted or "kicked" to suit, that is, it need not always be fixed square across the block.

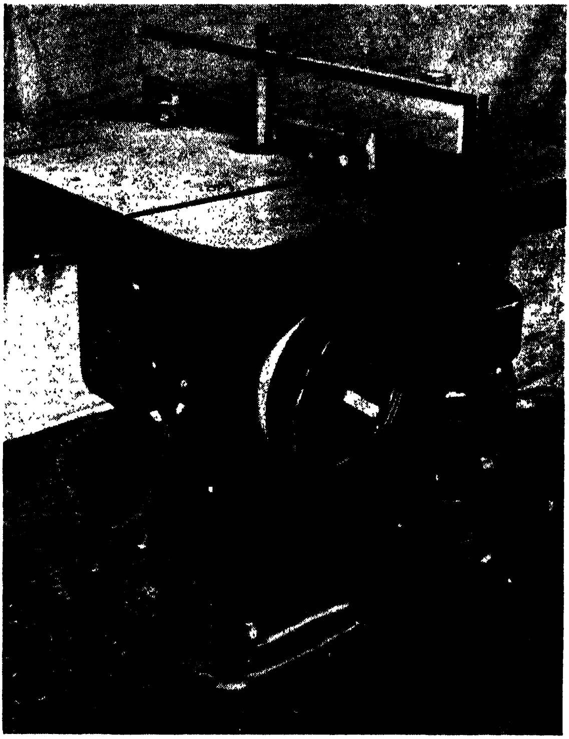

Fig. 52.—General View of Vertical Spindle Moulder, showing Method of Sticking Thin Straight Moulds

Timber is fed from left to right, between spindle and fence.

Operating the Square Cutter Block

The block can be removed from the spindle without disturbing the cutters, if it is likely to be required again for more of the same mould. Many people have several cutter blocks, each set up ready for stock jobs, such as transomes (double rebated and moulded), handrail, door frame, etc.

The cutter block gives a flatter angle of cut, which is an advantage for some kinds of timber, but for this reason the shape of the cutter is not the true shape of the mould and this must be allowed for when grinding the cutter, i.e., a cutter to make an ovolo mould half an inch deep will require grinding about $\frac{9}{16}$ in. deep, Fig. 53. If one has a lot of heavy work to do, say some big rebates—

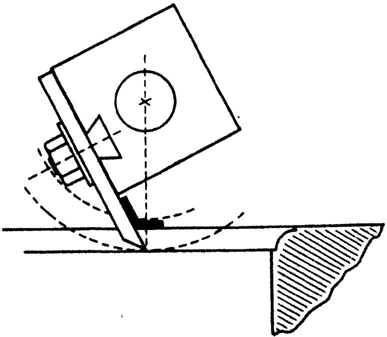

Fig. 53.—Square Block, showing Cutting Angle

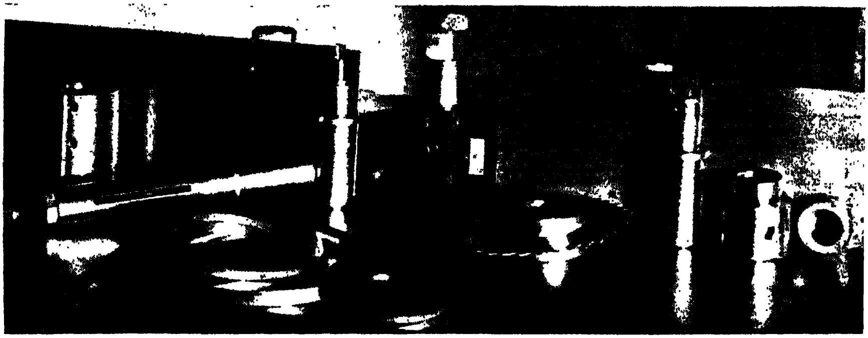

Fig. 54.—GROUP OF PARTS

Left to right: Circular cutter block, slot spindle, table rings, bored spindle with dovetail cutter, square block on spindle, wobble saw, flush top spindle with throating cutter, grooved collars.

Fig. 55.—SQUARE BLOCK WITH THREE PAIRS OF CUTTERS IN USE.

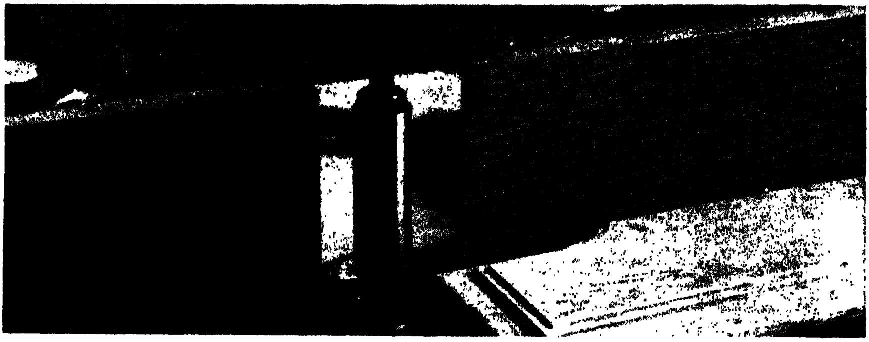

Fig. 56.—SLOT SPINDLE WITH ONE CUTTER.

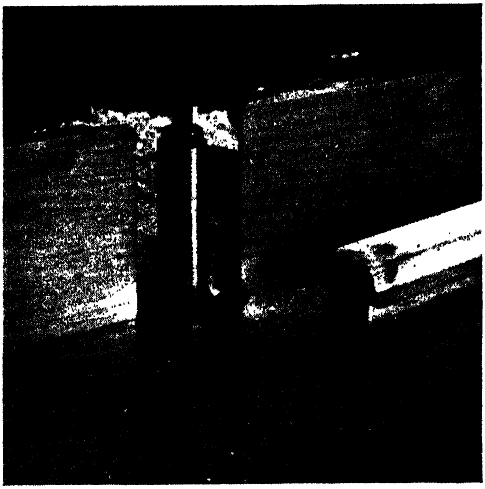

Fig. 57.—Slot Spindle with Two Cutters—Mould and Rebate

it is worth while putting two pairs of cutters on the block, each cutter taking the full width of the rebate or part of it; if the cutters are carefully set so that all are cutting, the timber can be fed quicker and the finish will be better.

The square block may take more setting up. It does, perhaps, look ugly and frightful, but for plenty of hard work it is unbeatable. Owing to the larger diameter of its cutting circle, the gap between the fences must be greater than for collars or slot spindle, and it is safer to screw a wood fence to the two iron ones covering the gap, and just cut away to allow the cutters to work through. Keep the projection of the cutters from the block as small as practicable, but they must project far enough to enable the bolts and nuts to clear the timber.

If the spindle has old-fashioned plain bearings and will not stand a high speed like ball bearings, use the cutter block whenever possible, because the cutter speed due to the larger periphery is higher.

Grooved Collars for Carrying Cutters

Grooved collars provide an alternative method of carrying cutters. The collars are usually 2½-in. to 3-in. diameter and the cutters ¼-in. thick iron, with steel face, are held between the two collars, in grooves. The nut on the spindle end provides the necessary pressure to grip the cutters securely.

Setting up Collar Cutters

Collar cutters are quickly set up and are very handy for small moulds, rebates, etc. They cut at a steeper angle, Fig. 60, than the square block, an advantage on hardwoods and coarse grains. Only two cutters can be used at once

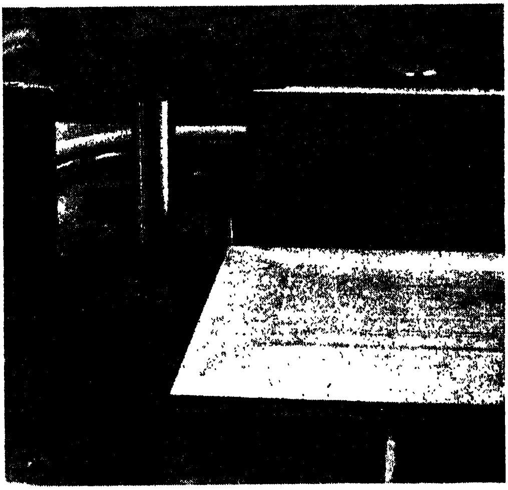

Fig. 58.—Slot Spindle with Double Ended Cutter, Raising a Panel

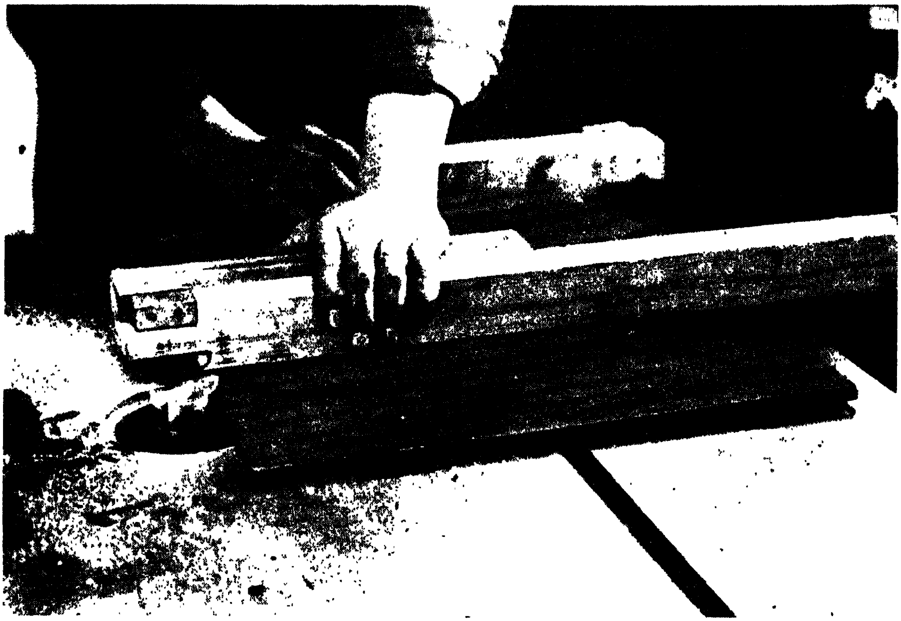

Fig. 59.—Flush Top Spindle—Scribing Sash Stuff

A piece of plywood is being used as a slide. The fence has a length stop against the back shoulder of the rail.

and their shape must be right, as they can only be fixed in one position. Both cutters must be *exactly* the same width, or one will be held tight and the other might be loose enough to fly out. Some machine makers supply a special fitting to prevent this, the top collar being made a slack fit on the spindle and having a semi-spherical sinking on its top side into which a washer of similar shape fits. This enables the collars to grip securely two cutters of *slightly* varying widths.

Collars are most useful for simple moulds, beads, ovolos, scotias, rebates, tonguing and grooving, chamfering, etc. Large compound moulds can be done one or two members at a time, but a section that requires handling three or four times with the collars could be struck all at one time with the cutter block.

French or Slot Spindle Method of Carrying Cutters

The French or slot spindle has a slot through the centre of the spindle three or four inches long, the cutters being held by a screw down the centre at the top. The cutters work at what we might call a back angle, or negative angle Fig. 61, slightly less than a right-angle. They scrape rather than cut.

Grinding and Sharpening the Cutters

These cutters are usually all steel and not tempered. They need not be ground as far back as other cutters, and when they have been carefully honed, the edge should be turned over like a hand scraper, and to resharpen, turn the edge back from the face (flat side) and over again—just the same as a scraper.

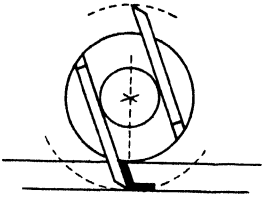

Fig. 60.—Cutting Angle for Slotted Collars

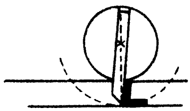

Fig. 61.—Slot Spindle —Angle of Cutting

Setting up the Cutters

The slot spindle was probably originally used for working small radius curves. The cutter need only project from the spindle the depth it has to cut. Slot spindles vary in thickness from ⅞-in. diameter to 1¼-in., but the best makers to-day fit 1½-in. diameter. Most slot spindle cutters are $\frac{3}{16}$-in. or ¼-in. thick. (For very delicate work we have known slot spindles ½-in. diameter with cutters $\frac{1}{16}$-in. thick.)

Working with the Slot Spindle

The slot spindle is not, however, confined to small radius work or even to curved work. Owing to its scraping cut it is eminently suitable for end, cross, or curly grained timber, and in recent years has become increasingly popular on plain joinery in both hard and soft timbers.

Speed

The chief essential to successful work with this type of cutter is high speed. It works well at 6,000 r.p.m., but the nearer it can be run to 8,000 r.p.m. the better, and the best spindle moulders to-day provide for 8,000 r.p.m., with an alternative speed for the square block around 4,000 r.p.m.

For Light Work

For light work only one cutter is used and this is a great advantage and an economy where a variety of moulds in small quantities are required—a small cutter in this untempered steel can be quickly ground or filed to shape—the steel is usually supplied in lengths of varying widths from ½-in. to 2-in., etc.

Fig. 62.—Flush Top Spindle—Throating Sill

Note lath to prevent sill tilting over.

Fig. 63.—CIRCULAR WORK ON COLLARS

Using template and ring fence to lead in—but working on the collars.

Many jobs can be done using a single cutter in the slot spindle. Fig. 56, but whenever possible a balance piece of steel should be put either under or on the top of the cutter and projecting from the slot on the opposite side. Two cutters can be used, as shown in Fig. 57, with a spacing piece between if necessary, as in this example.

If a job requires a long cutter, a balance piece can be used, but it is best to make a double-ended cutter, as in Fig. 58. A collar with a slot across the centre is useful to strengthen long cutters. While heavy work generally is best done with the square block, sometimes the slot spindle is most suitable, but long cutters should not be run at the higher speed.

Solid cutters of high speed steel, although costly, are useful for stock moulds required in big quantities. They are made like a circular disc with the edge turned to the required shape, several teeth are then cut. Run at a high speed with all the teeth (3, 4, 5 or 6) cutting, they produce a lot of work, and never lose their shape with sharpening, as this is done on the face of each tooth.

Using a Flush-top Spindle.

A flush-top spindle is often useful, especially for scribing and throating, as either of these jobs would require a dangerously long cutter to clear the length of the tenons or the depth of sills, transomes, etc. Fig. 59 shows this spindle in use for scribing ovolo sash rails. It will be noted that a piece of plywood is being used as a slide. It has a strip of hardwood screwed to its underside, which fits the dovetailed slot in the machine table, and the fence has a length stop against the back shoulder of the rail.

The cutter is sharpened and turned over like a scraper, just as described for slot spindle.

It is always best to scribe before the mould is put on, so that if there is any spelching, the sticking of the mould removes it. If, however, stock stuff, ready moulded, is being used, spelching can be prevented by shaping a piece of hardwood to fit the mould and screwing it to the fence, or, if the cutter is double-

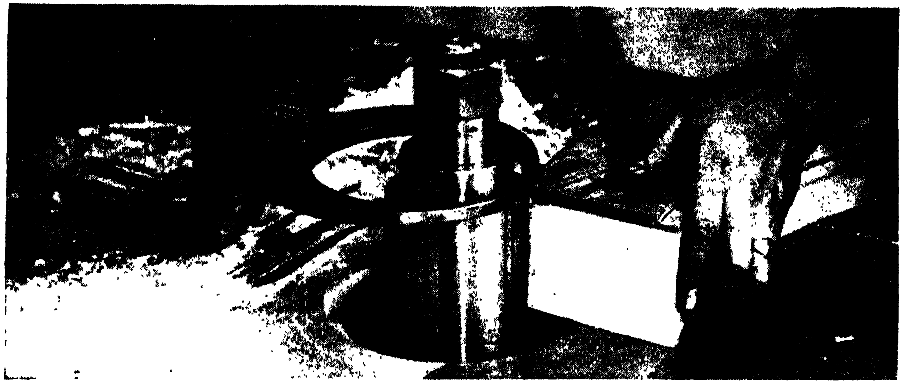

Fig. 64.—CLEANING UP A SWEEP AFTER BANDSAWING
Using template, ring fence, and circular block.

ended (which it should be for reasons of balance), one end of all the rails can be scribed from one side of the spindle and then the spindle reversed and the other ends of the rails scribed from the other side of the table. However, if the cutter is properly sharpened and run at high speed it will not spelch excepting in very poor quality timber. Fig. 62 shows this flush-top spindle being used for throating a sill; also note the lath to prevent the sill tilting over.

Top Spindle for Special Types of Cutters

Yet another type of top spindle is often used for special cutters having turned round shanks, like the cutters used for routing stair strings, Figs. 68, 69 and dovetailing, Fig. 70.

METHODS OF WORKING SHAPED OR CIRCULAR PIECES

Circular, or shaped work is done in various ways. Heavy work, such as door frame heads, can be moulded and rebated with the square block, using the eccentric ring fence. After the sweep has been cut on the band saw, screw the template, which was used for marking out the plank, on the top side of the sweep and, having set the cutters on the block, fix the ring fence over the top of the cutter block so that the edge of the template will rest against it. The ring is eccentric and should be so set that the cutters will cut the depth required when the template is resting against the thin centre of the ring.

Start cutting at the side where the ring is wider and gradually work the timber round to the front. Take care at the end of the cut because the corners of a circular piece are short-grained and might break away.

With heavy work of this nature it is a good thing to put the timber through twice, once on the side of the ring and then again at the centre. This makes a cleaner job. Circular work can be done with the slotted collars or the slot spindle, dispensing with both ring fence and template and letting the wood run against the collars or spindle respectively, but the curve must first be cleaned up true with template, ring fence and cutters. If the shape is run against the

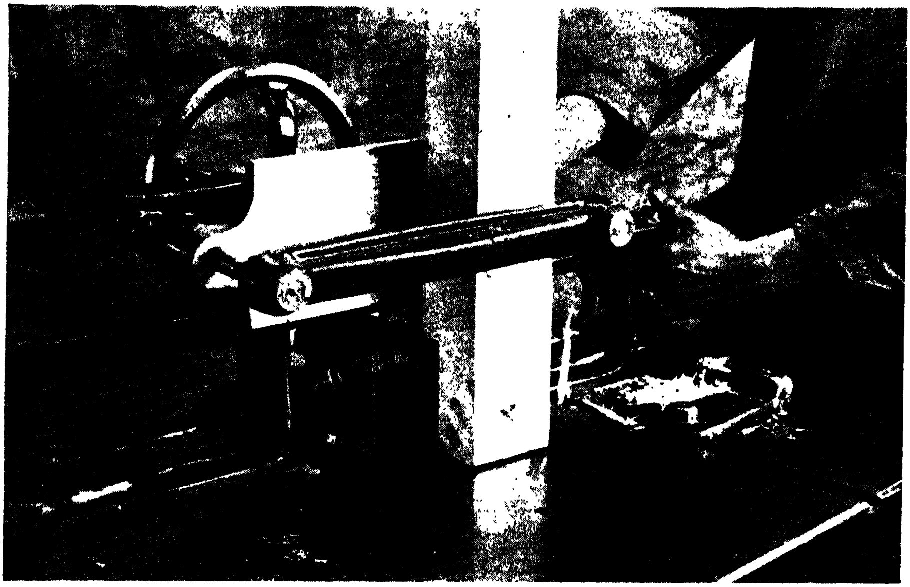

Fig. 65.—TENONING WITH SPECIAL ATTACHMENT—FIRST STROKE FORWARD
Timber held in cramps is passed in front of cutters, so cutting one side of the wood.

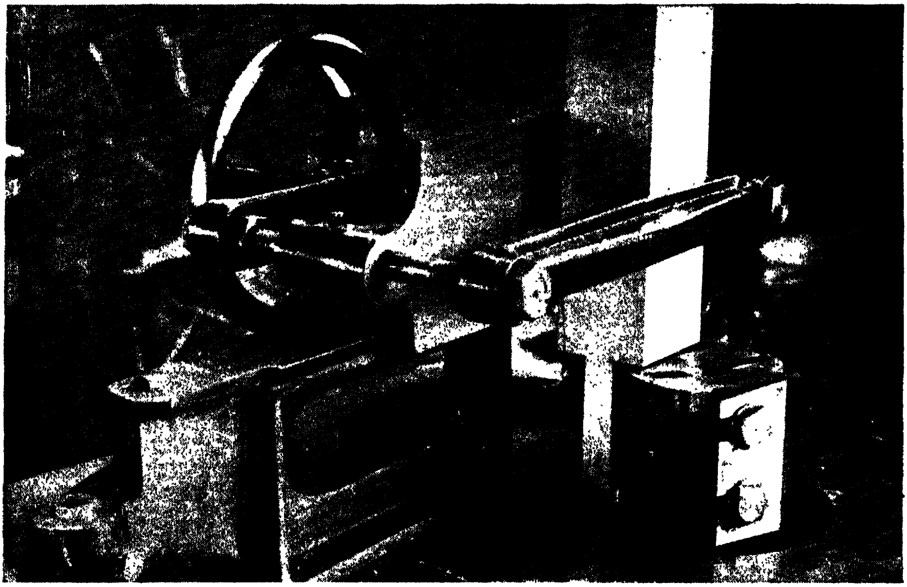

Fig. 66.—TENONING WITH SPECIAL ATTACHMENT—SECOND STROKE RETURNING
On the return stroke the timber passes at the back of the cutters and the tenon is completed.

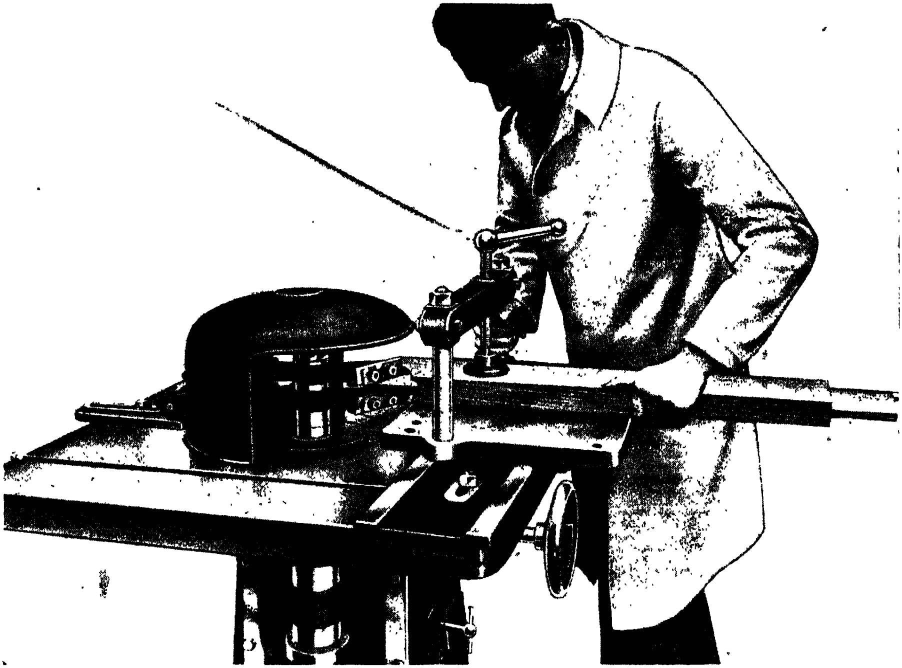

Fig. 67.—ANOTHER TENONING ATTACHMENT FOR VERTICAL SPINDLE MOULDER

For cutting single and double tenons up to 5 in. long, 11 in. wide. Both sides of the tenon are cut, and scribing is done at one movement past the cutters. The cutter-blocks are designed to give a shearing cut, and leave a clean shoulder in the work. Angular tenons can be cut with equal facility.

(*Wadkin Ltd.*)

collars straight from the bandsaw, all the bandsaw marks and any irregularities in the sawing will be reproduced on the moulds.

Working with Slot Spindle or Slotted Collars

When working with slot spindle or slotted collars, either straight or shaped work, it is best to use some kind of fence to lead the wood on to the spindle at the start. Even the experts frequently screw a piece of wood to the table for this purpose, especially for heavy cuts.

Moulding Where Whole Surface is Removed

Any mould where the whole surface is removed, nosings, picture rails, handrails, some architraves and planting moulds, etc., require special treatment.

Straight pieces can, of course, be done on the straight fence, with the back half of the fence so far forward of the front half as to receive the mould on its new face as it leaves the cutters.

Curved pieces must have a template screwed on, to rest against either the ring fence or the slot spindle or collars. The ring fence can be fixed either over

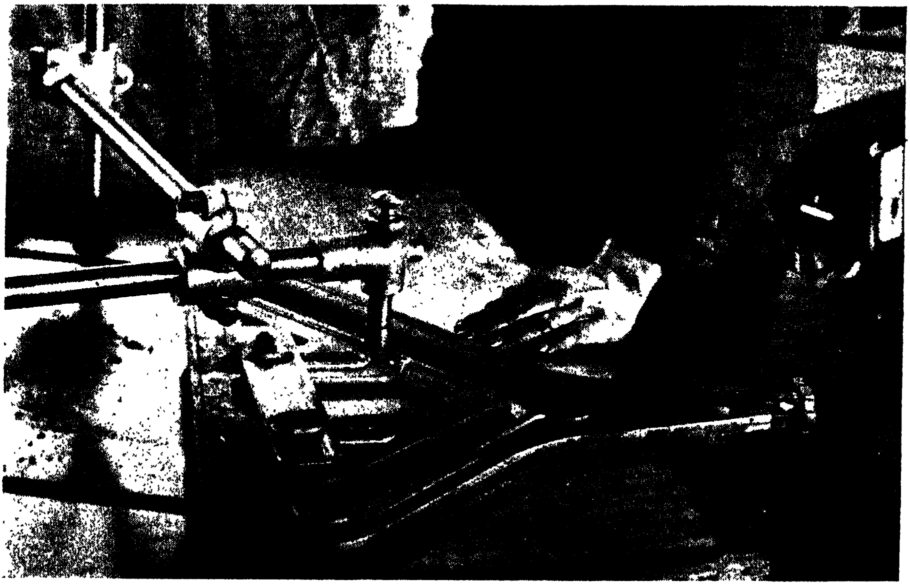

Fig. 68.—Stair String Housing Attachment in Operation

This attachment is used with a top spindle, having special type of cutter with turned round shank.

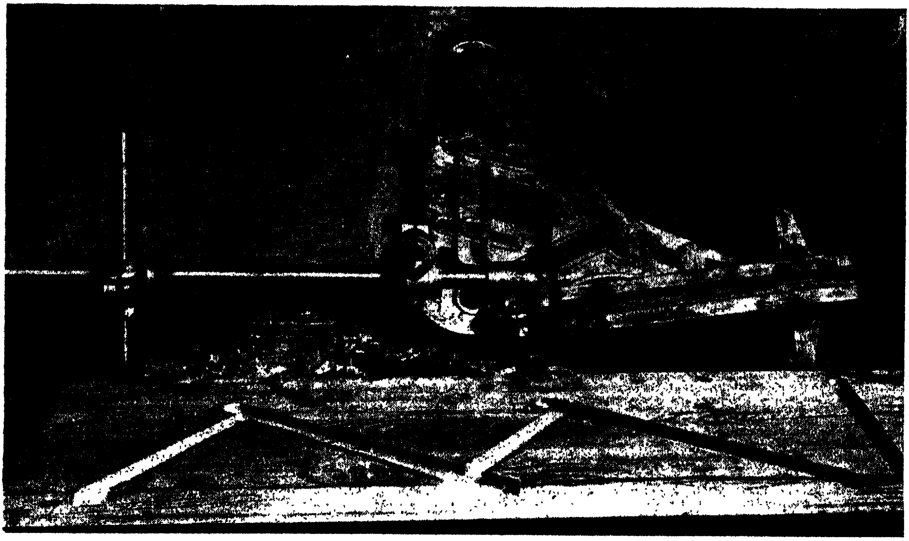

Fig. 69.—String Completed

Also shows templates for stairs and shelf trenching and sample trench.

the cutters or on the table under the cutters, as is most suitable for the job. A ball-bearing washer is very useful to run the template or mould against; it can be put either on top or below and reduces friction, prevents the wood being burnt and makes it more easy to hold.

Working Small Pieces

Do not take unnecessary risks when working small pieces, a jig is quickly made to hold one or several pieces. If their shape is suitable, a number of small pieces can sometimes be held in a small sash cramp and fed past the cutters as one piece.

Working Panels or Caps

When working panels or caps, always work the end grain first, then the spelches at the corners are removed as the sides are moulded.

Glass Beads, Corner Fillets, etc.

Small glass beads, corner fillets, etc. should be struck on larger pieces and sawn off afterwards.

Work with Thin Edges

Picture moulds, thin planting moulds, light sash bars, some architraves which have thin edges, require a saddle fixing to the back part of the fence or the table to support them after they pass the cutters, and prevent them wobbling and perhaps causing an accident, or at least spoiling the job.

Another Method of Working Straight Moulds

Fig. 52 shows another method of working straight moulds, especially thin ones: it is safer and ensures all the moulds being of equal thickness, a big

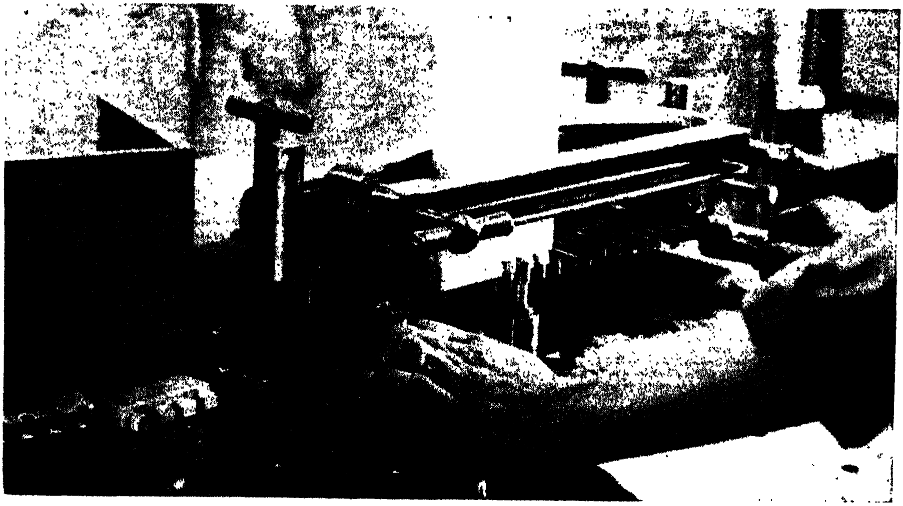

Fig. 70.—Dovetailing Attachment for Vertical Spindle Moulder advantage when mitreing them around panels, etc. The straight fences are fixed behind the spindle and the wood is fed between the fence and the cutters, springs or rollers being used to hold the timber steady against the fence and table. The two halves of the fence are closed in the centre.

Whenever possible arrange the cutters to work at the bottom of the wood near the table; this rule has several exceptions. Raising panels is best done with the cutters on top, so that the panel edges are all the same thickness to fit the plough grooves; the groove and mould on the top of a picture mould, so that it rests on its flat back on the table.

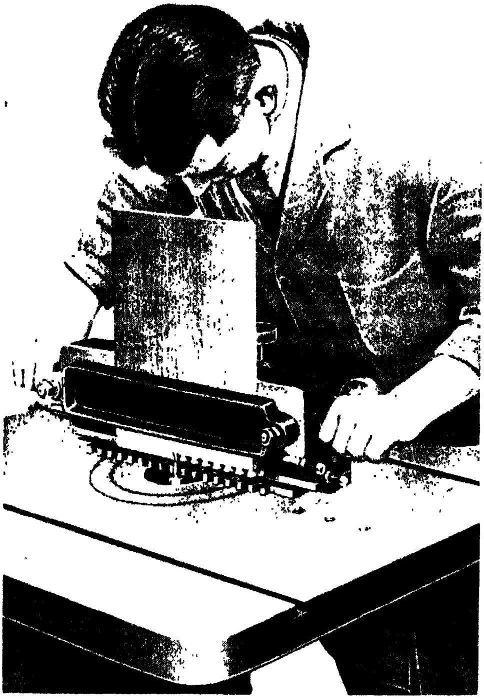

Fig. 71.—ANOTHER DOVETAILING ATTACHMENT

Two boards are clamped together in position at right-angles to one another, suitable stops being provided for the setting. A guide plate of the desired pitch is fitted and the attachment moved round the cutting tool by hand. Both the dovetail and the pin are produced at the same operation, and the pin is rounded so that no handwork is necessary. Provision is made for producing tight or loose fits as desired. The attachment is made to take boards 12 in. wide.
(*Wadkin Ltd.*)

Handrails

When making handrails, mould the top first, then groove the bottom, then the two sides. By doing them in this order there is always a flat side to rest firmly on the table.

Balancing the Cutters

Balancing the cutters is most important and the only perfect balance is a pair exactly alike; this applies to the collars, but especially the square block, where the larger diameter of the cutting circle increases all the forces.

Keep the projection of cutters down to the minimum; this also ensures the smallest possible gap between the fences. If a big gap is inevitable, screw a wood fence over the iron ones—full length, a thin piece will do—and cut out just sufficient for the cutters to work through. The best way to do this is to set the cutters and spindle right for height first, then, having screwed the wood fence on, start the machine and slowly and gently let the fence back allowing the cutters to cut through the wood fence. A modern fence with screw adjustment is an advantage for this operation.

Guards

There are several types of guards for spindle moulders, and many jobs which cannot be guarded, and some for which the operator must make a

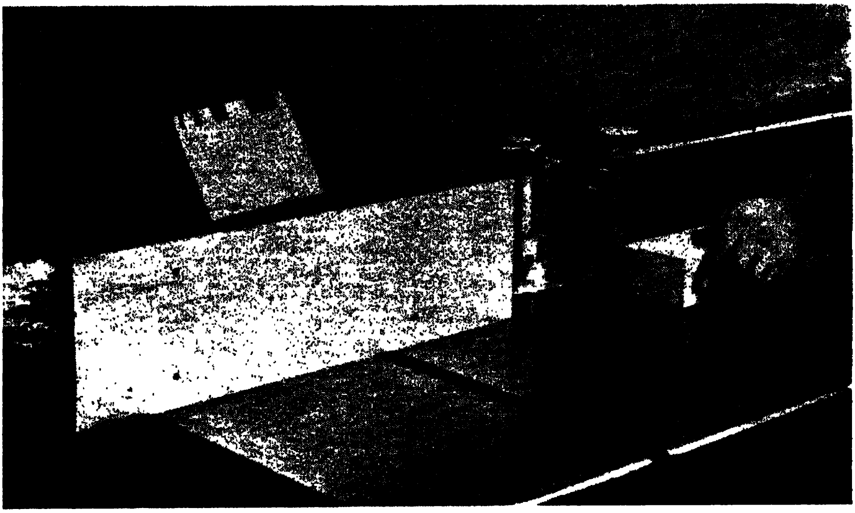

Fig. 72.—Wobble Saw, showing Several Grooves of Different Sizes Made with it

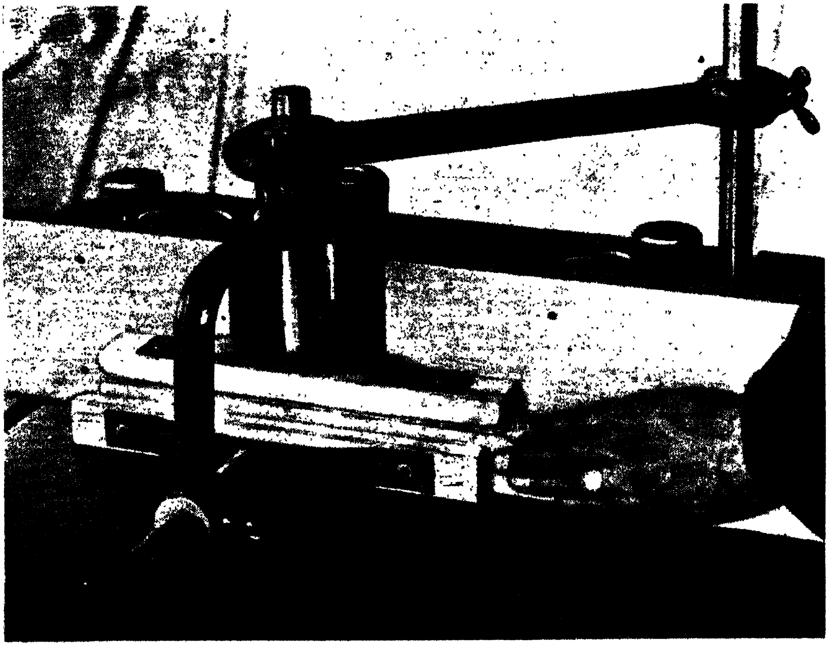

Fig. 73.—"Shaw Guard"—Springs and Guard Combined

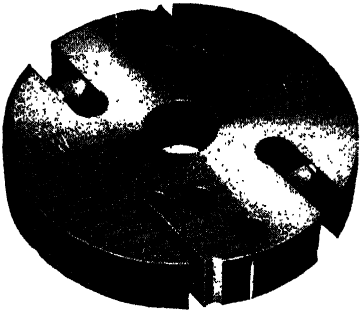

Fig. 74.—WHITEHILL PATENT CUTTER HEAD (*Whitehill Spindle Tool Co.*)

wooden guard. The most effective and useful is undoubtedly the "Shaw Guard," which combines guards and springs (Fig. 73).

Springs, to keep the wood steady on the table and fence, should be used whenever possible—especially on light work.

USEFUL ACCESSORIES

There are many useful accessories for this machine.

Working with a Small Wobble Saw

A small wobble saw, say 7 in. diameter, will cut grooves any width from its own thickness, ⅛ in. up to 1½ in. or more, it is quickly set and works well. Fig. 72.

Circular Cutter Block

A circular cutter block is handy and safe for many jobs; it will plane narrow stuff, rebate, shute joints and is the best and safest tool to use with ring fence, for cleaning up shaped pieces after bandsawing. Fig. 64.

Tenoning Attachment

This is a great help to a joiner. It quickly produces perfect tenons equal in every way to an expensive tenoning machine; in fact, the cutter head is identical with those used on the best tenoning machines. The timber held in the cramp is passed in front of the cutters, Fig. 65, and returns at the back, Fig. 66, meeting the cutters each stroke and completing the tenon. The apparatus is adaptable to several other purposes. Shouldering or tonguing the ends of panels or boards or, by substituting moulding cutters, sash stile horns and similar jobs can be moulded.

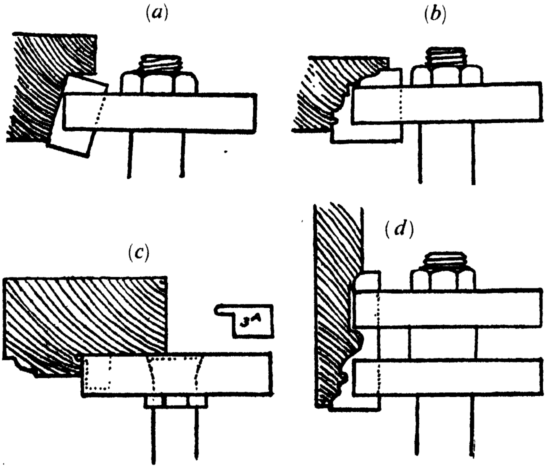

Fig. 75.—WHITEHILL CUTTER HEAD

(*a*) Cutter Tilted. (*b*) Small Projection. (*c*) Flush Mounting. (*d*) Two Heads in Tandem for Big Moulds.

(*Whitehill Spindle Tool Co.*)

Stair String Housing, Trenching, etc. Attachment

Stair strings can be housed complete for nosings and wedges with another efficient yet inexpensive attachment, as shown in Figs. 68 and 69. This apparatus can also be used for trenching shelving, church seat ends, and moulding sunk panels in coffin sides.

Dovetailing

Dovetailing has been done on the spindle moulder for a great many years, but the method shown in Fig. 70 is cheaper, handier and quicker and is invaluable where drawers, boxes, etc., are required. It makes a strong and neat looking dovetail.

Corner Locking, or Combing

Corner locking, or combing, can be done, too, on a good spindle moulder equal in quality and probably quicker than on a special machine.

Whitehill Patent Cutter Heads

Since this article was first printed Whitehill Heads have taken a front seat. They are one of the best inventions, in woodworking for many years. The illustrations show clearly their construction.

This Cutter Head is safer, the cutters are held securely in a vise grip, and there are no projecting bolts or nuts. The cutters will therefore work with the minimum projection. The circular symmetrical shape of the head and the thin light cutters, ensure perfect balance and permit high speeds, while on the other hand, on a low speed machine a high peripheral speed is available by using a larger head. The moderate cutting angle produces a fine finish on most timbers in general use. The cutters are of high speed steel and retain their cutting edge a long time. Different profiles may be ground on the four sides of a cutter, and they can be tilted to any angle, a valuable feature.

These heads are available in many diameters and several thicknesses. For heavy work two heads may be used in tandem with spacing washers between.

Primarily designed for spindle moulders, they are ideal on a sawbench, are used on travelling head cross-cuts, tenoning machines and the side heads of four cutters.

CHAPTER VI

BAND SAWING MACHINES

THE band sawing machine has been in general use for many years and one can imagine the delight of the first man who made one, perhaps a country wheelwright, or even a boy, who had previously spent weary days and weeks cutting ash planks into wheel felloes with pit saw and bow saw. That first band saw ought to be in the British Museum. Perhaps it is.

Band saws were invented for cutting curved work, but are largely used for other purposes. In America, band saws have largely displaced circular saws and that is the tendency in this country. In fact, they cut with so little waste, compared with circular, frame and log saws, that it is surprising they are not more used in a country which imports most of its timber.

This chapter deals with the smaller machine, which is sometimes called a scroll saw, using saws from ⅛-in. to 1½-in. in width.

A Useful Machine for the Joiner

Band saws are one of the most useful machines there are for woodworkers. Ship, boat, and motor body builders, wheelwrights, brush-makers, chair frame and cabinet-makers, and pattern makers find them essential, but many joiners try to do without them because they don't do much circular work. Yet, a joiner's kit usually includes a pad saw, a compass saw, and a bow saw. When a joiner does get a band saw—he invariably finds it so very useful that he wishes he had installed one earlier.

The modern machine is so guarded that only that portion of the saw which is actually cutting is exposed, thereby ensuring safety:

To get the best out of any machine the operator should understand its working parts and construction.

Faults in Design and Installation

Band sawing machines are very susceptible to vibration and should have a substantial and well-proportioned frame. They will not work well on a springy floor.

The Wheels

It should be realized that the saw blades are, compared with most tools, delicate and sensitive, therefore the wheels on which they run must be perfectly balanced and run in good bearings. The top wheel especially, being driven by the saw, must revolve freely. Ball bearings were applied to the top wheels of band saws years before they were used in other woodworking machines.

Wheel Covering

It may sound superfluous to say that the wheels must be perfectly round—but they are covered with some resilient material to preserve the set of the saw, and if this is irregular in thickness or lumpy, trouble will ensue. The best covering is rubber, vulcanised to the wheels and afterwards ground true. The face should be slightly round.

Tension of Saw

The top wheel is carried on an adjustable slide which can be raised or lowered by means of a screw, to give the correct tension to the saw. The "correct" tension is difficult to state and is largely a question of experience, tight without being strained. A broad saw requires more tension than a narrow one. In addition to this adjustment, provision is made by means of either a weighted lever or a spring, for compensating the tension automatically as the saw expands or contracts while working; and the slide must be kept clean and lubricated so that it works freely. This compensating movement is most important and its efficiency really decides the speed at which the machine will run and work satisfactorily.

Quite recently an important improvement has been made in some British band saws. The weight of the top slide has been taken from the compensating spring, leaving only the weight of the wheel, so that a lighter and more sensitive spring can be fitted, and the efficient speed of the machine is practically doubled and saw breakings reduced to the minimum.

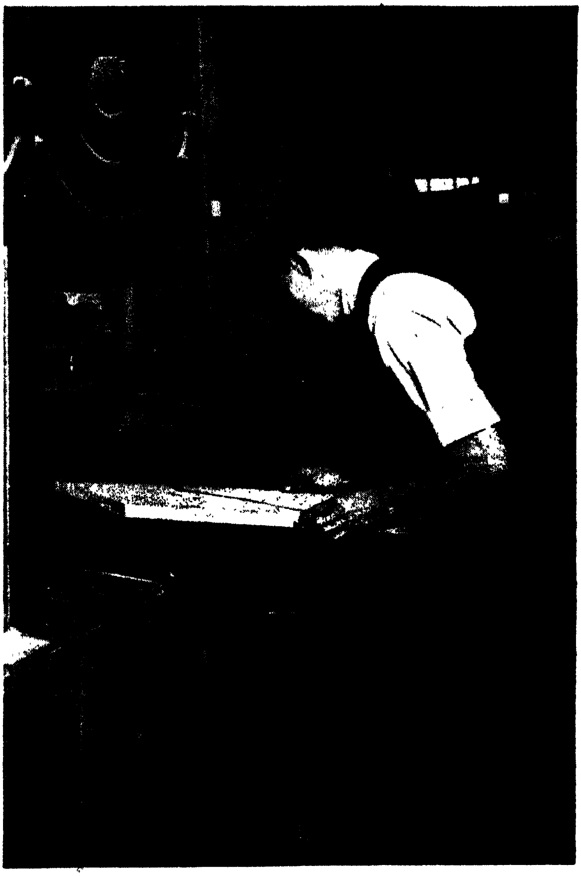

Fig. 76.—BAND SAW IN ACTION—CUTTING RAMPS

As the fence is not required in the above operation, it has been swivelled out of the way, and is shown hanging from the table at the side. Note the casing below the table to protect the operator and keep the bottom pulley clear of sawdust.

Back Support for Saw

When cutting, the saw requires some back support, and there are many patterns. The best is an anti-friction guide with a hardened steel disc running on ball bearings. This disc is not fitted centrally with the saw, but so that the back of the blade rests on the face towards the edge and causes the disc to revolve. Wood or brass side supports 3-in. or 4-in. long are included with this type of guide.

Whatever type of guide is used the thing to avoid is letting the saw run on stationary metal, as it heats and crystallises the back of the saw so causing cracks. Very old machines had flanges on the wheels—but they are never made today on this account.

When putting a saw on to the machine, push the disc runner back quite clear ot the saw. Put the saw on and adjust the tension, give the wheel a spin by hand, noting whether the saw tends to run backward or forward. To correct this the top wheel can be tilted. On a modern machine with a lever behind the wheel, it may be operated while the machine is running. When the saw runs steadily in one position start the motor,

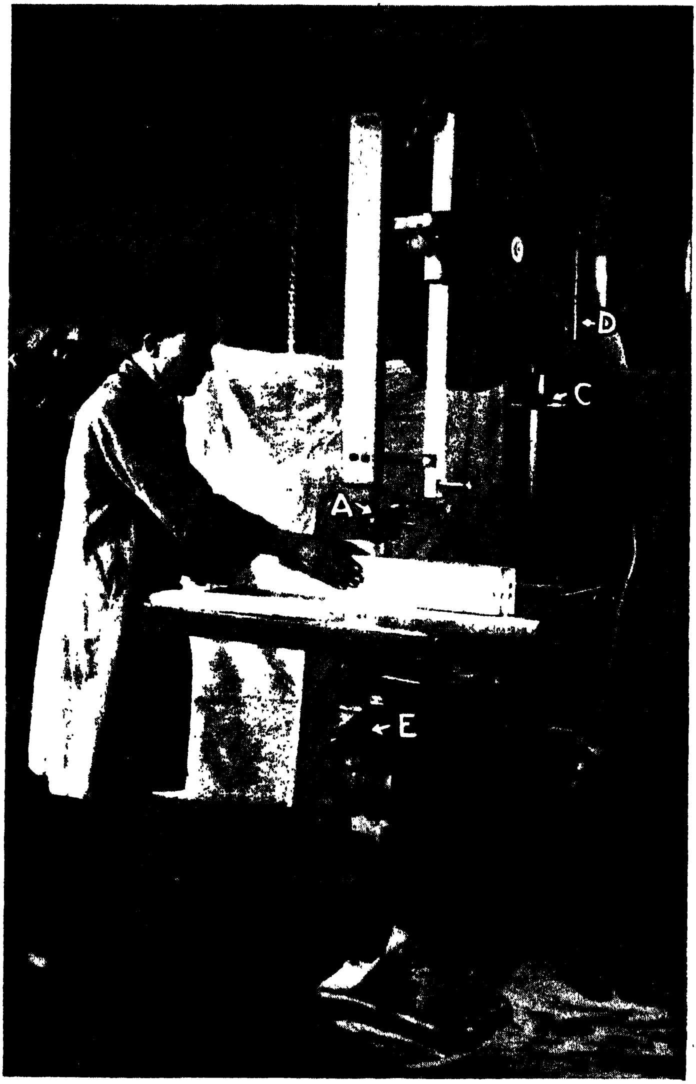

Fig. 77.—RIPPING—USING STRAIGHT FENCE

The fence F is behind the wood. A is the top guide. C tension adjustment. D tracking lever. E bottom guide.

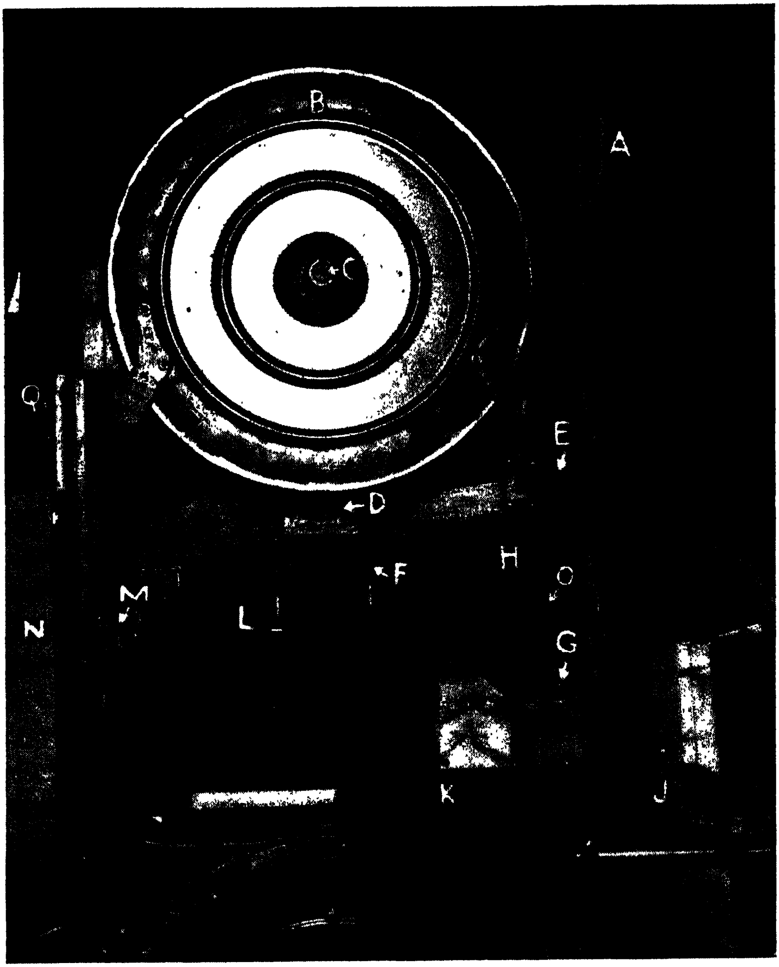

Fig. 78.—Top Part of a Band Saw

A, guard to protect operator. B, top pulley inside metal guard. C, spindle of pulley. D, brush to keep face of pulley clean. E, screw for setting position of top guide. F, adjustment device for pulley. G, top friction guide. H, adjustable slide bar. J, fence for straight cutting. K, table. L, wheel for lowering and raising top pulley when changing saw. M, saw guide. N, guards to protect operator. O, band saw. Q, lever and weight to regulate tension on saw.

the tracking lever or the tension screw may require another touch. *Now* adjust the disc runner until it just touches the back of the saw.

We do wish to dispel the impression that the disc runner is to keep the saw from running off the wheels, a saw should run all day idle without any support of this kind. The disc is an anti-friction devise to oppose the pressure when cutting, without heating the saw. The wood side pieces should be adjusted to

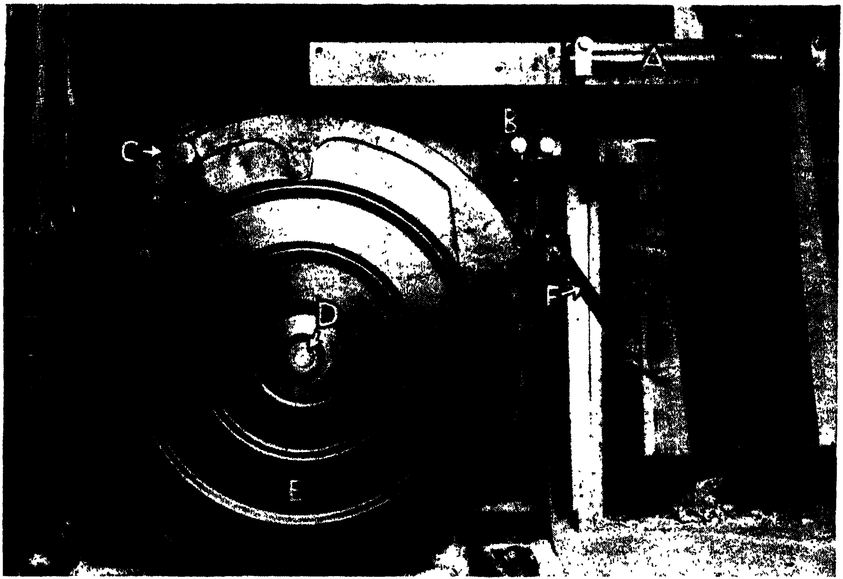

Fig. 79.—BOTTOM PART OF A BAND SAW

A, spindle to swing fence out of action. B, bottom saw guide. C, brush to keep face of pulley clean. D, spindle of pulley. E, metal guard casing over pulley. F, starting lever and brake.

Fig. 80.—HAUNCHING TENON AND CUTTING WEDGES OUT OF THE WASTE steady the blade not too tight. A lot of force to make the saw cut should not be needed: *Keep the saws sharp,* blunt saws are the cause of most band-saw troubles.

OPERATING THE BAND SAW

When sawing, lower the guide as near the table as the thickness of the wood will permit. Do not attempt to force or hurry the cutting. Allow the saw to cut, and when force is required, change the saw for a sharp one: 95 per cent of saw troubles are due to improper or insufficient sharpening or setting.

Sawing Curved Pieces

When sawing curved pieces, use a saw suitable to the radius of the curves to be cut, the smaller the radius the narrower the saw. The prevalent idea that an inch saw with extra set on the teeth will cut a quick curve, which should have a ⅝-in. or ½-in. saw, is wrong.

To Save Sharpening

Too much set on any saw puts a big strain on it, each lot of teeth, right and left hand, are really cutting a separate groove and the piece between is not really cut at all. Not many of us are ambidextrous, but when a lot of sweeps are being cut it is best to try and cut some right hand and some left, if we cut them all one way it takes the set off one side of the saw and it requires sharpening and setting before it should do.

Use of Canting Table

Every band saw should have a canting table to enable curved angular pieces to be cut; this is also very useful for taking corners off heavy mouldings and thus easing the work of the spindle cutters.

An adjustable fence which can also be canted is even more useful than the canting table and the two can often be used in combination.

Straight angular cuts can often be done easier with the table level and the fence tilted, because there is not the same tendency for the timber to slide away from the saw. When for one reason or another the table must be canted, the fence can be set square with the table, and the edge of the timber resting against it is prevented from sliding away down the sloping table.

Ripping with the Band Saw

A band saw is very useful for ordinary ripping. The fence is essential for this operation and it is best to use a wide saw, 1¼ -in. or 1½-in. Ripping by the band saw is slower than by the circular saw (excepting a few of the very latest machines which run much faster) but there are advantages to balance the lack of speed.

Replacing the Circular Saw

Suppose the circular saw is not quite big enough or has not sufficient power (a band saw takes much less power than a circular saw—usually about 25 per cent) to deep cut a deal—the band saw will do it and also produce much thicker boards. A 30-in. or 32-in. circular saw—gauge 11 or 12 required to

Fig. 81.—Tenoning with Band Saw
Showing the Position of Saw Blade on Disc Runner Guide.

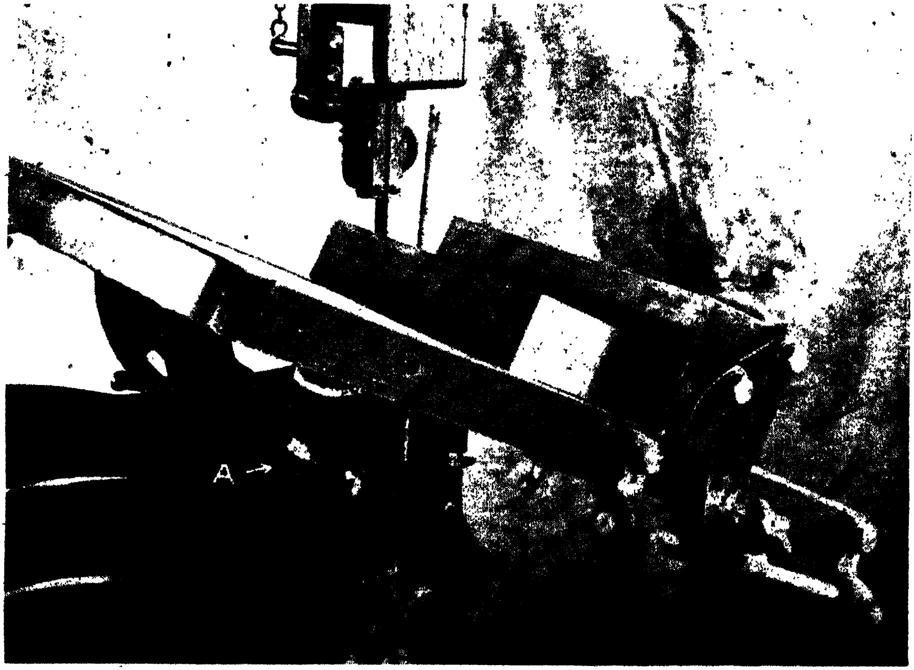

Fig. 82.—**Angular Cut with Table Canted**
Also using the fence.

deep an 11-in. deal would waste at least 5/32-in. and probably 3/16-in., whereas the band saw—18 or 19 gauge would hardly waste 1/16-in. This is quite an asset when expensive timber has to be cut and is required to finish as thick as possible.

ODD JOBS WITH THE BAND SAW

Band saws are useful for many odd jobs. Tenons can be haunched and wedges cut out of them with a narrow saw; double tenons cut out, square turned newels, etc. can be cut, and large moulds scribed. Sometimes a pilaster has several moulds mitred round it and to save mitreing the short returns, the mould is struck on a solid piece ends and sides, and then cut out inside to fit over the pilaster—this is another job for the band saw, hammer headed keys and similar jobs.

Sheets of plywood are more easily cut up than on a circular saw.

Size of Machine

Band sawing machines are made in many sizes, the diameter of the wheels denotes the size, from 12 in. to 48-in. The popular sizes are 30-in. and 36-in. It is always advisable to have the largest machine that space and means permit; it will break less saws and give better service all round. For heavy work a large machine is essential, but the larger table and greater gap are often an advantage, even though the work be light.

Sharpening

This depends upon the different classes of timber and the size and speed of the machine.

Obviously the 25 or 30-ft. saw on a big machine will do more work than a 14-ft. saw on a small machine. The average 30-in. machine with 17-ft. to 18-ft. saw running at 500 r.p.m., and

Fig. 83.—STRAIGHT CUTTING WITH THE BAND SAW
Showing the fence in use.

Fig. 84.—Cutting a Mould which has been Struck on a Larger Piece for Convenience and Safety

Fig. 85.—A Circular Cut at an Angle—Table Tilted

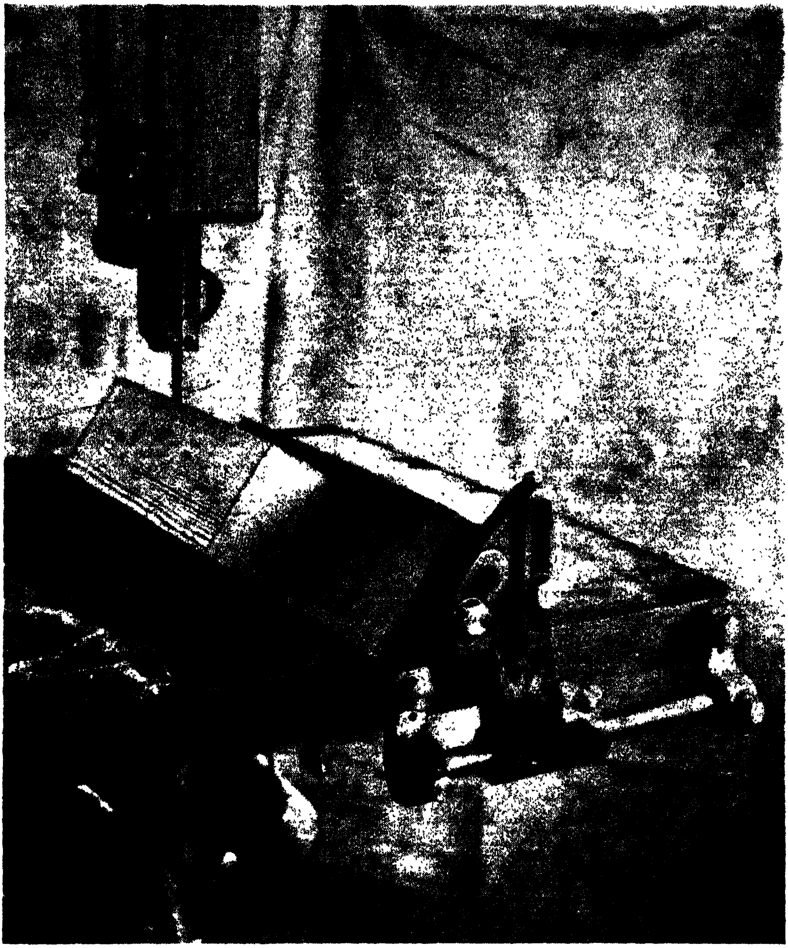

Fig. 86.—ANGULAR CUT WITH FENCE TILTED AND TABLE LEVEL

cutting clean red deal, will probably do three hours' work without sharpening.

It pays to sharpen often, forcing work against a blunt band saw will either spoil the work or break the saw, probably both.

How to Sharpen

Band saws should be sharpened square across and usually every tooth from the same side. The teeth should be square up on the front, i.e., without hook. When sharpening use a three-sided file with round corners, an ordinary hand saw file will not do, as sharp angles in the gullets cause cracks. Hold the saw in a vice, as near the gullets as possible.

Fig. 87.—To Ease Work when Moulding

Taking a corner off the block to ease work of cutters when moulding.

Setting the Saw Teeth

Band saws require very little set; either a pullover set or an ordinary lever set can be used. Experts sometimes set with a hammer on a bevelled block. Some inexpensive setting machines can be purchased which are quick and efficient.

Brazing Broken Saws—Equipment Required

Saws will break occasionally on the best machine in the hands of a skilled operator, and require brazing. Many people do not attempt to braze their own, but with proper appliances and some practice it is not a very difficult job, although done very indifferently in some districts by people who braze and sharpen saws to the trade.

The chief requirements are some means of holding the saw and some method of applying the necessary heat.

The various appliances can be purchased complete—if the number of breakages justify the expense. Some use hot tongs; a furnace using gas and complete with bellows is another method. If electricity is not available, the blow lamp outfit is best.

The electric brazer is the best of all; it is quickest and most reliable and has the advantage of restoring the temper of the saw. One of these is shown in Fig. 89.

Fig. 88.—SETTING BAND SAW TEETH

How to Braze

First file the two ends square, then bevel the ends of alternate sides for about ½-in. to ⅝-in., two teeth, taking care to file the bevels quite flat, and of even thickness. Don't file the ends too thin. Thoroughly clean the joint and smear with borax paste or brazing solution. Clean a piece of silver solder and place it between the laps (alternatively, the joint can be wrapped with thin brass wire). Now place the saw with its back edge to the fence in the brazing machine, the joint in the centre of the well. Clamp securely, taking care that the back of the saw is straight—apply the blow lamp to the joint and heat until the solder (or brass) melts. File the joint flat and smooth with emery paper. It is most important that the back of the saw be kept perfectly straight and the joint the same gauge or thickness as the saw and not twisted. Do not set the teeth where the braze is.

Brazing with the Electric Brazer

Prepare the saw by filing and cleaning in the manner described above. The bevels must extend from the gullets of the teeth. Insert the saw in the machine with the back edge pressed well up to the fence (see Fig. 96), and with the two bevelled portions in the centre of the clamp plates. Lock one clamp plate only.

Cut a strip of silver solder about half-inch longer than width of saw and place it carefully between the two bevelled surfaces. The solder must be handled on the edges only. Secure the other clamp plate. Apply brazing solution all over each joint with a brush.

The switch is now turned on to the first notch, when the current will flow and heat the saw blade; turn switch to second and third positions, when the saw will reach a red heat. Keep switch on until the solder begins to flow. Now firmly clamp the joint in the jaws of the hand lever, as shown in Fig. 96.

Tempering

The current is cut off, and the saw tempered by the graduated switch being turned back with a pause in each notch, while the brazed joint is held firmly by the jaws. When the saw assumes a blue colour release the jaws.

The braze is now complete and the joint cleaned off on both sides with a file until it is the same thickness as the rest of the blade.

FINDING OUT WHY SAWS BREAK

If the band saw breaks frequently or breakages increase, the following hints may help to find and remedy the trouble.

Worn Bearings, Belts, etc.

If it is an old machine with plain bearings, perhaps the top wheel bearings are worn and cause the saw to jump. Or the pull of the belt has worn the bottom wheel bearings and the two wheels are out of line.

The coverings or tyres may be worn or resin or sawdust has made them lumpy.

Fig. 89.—An Electric Band Saw Brazer in Operation

Notice the back edge of the saw is placed against the fence of the device and the saw is clamped down with the lap in the centre.

(*Wadkin Ltd.*)

Tracking in one Place

If you use a lot of saws, don't always run them on the same part of the wheel faces, the tracking device on the top wheel should be used to run the saws on different parts of the wheels.

Too Much Tension

Examine the saws for cracks; too much tension will sometimes account for these.

The tension should always be released when the machine is to be out of action for any length of time—especially at night. If the saw has been running some time and it is left without releasing the tension—the shop cools during the night and the saw contracts and puts a big strain on it.

Blade Faulty.

The saw may be running too hard on the guide or this may be faulty, a burr on the back edge of the saw is certain evidence of this.

Speed Too Fast

The machine may be running too fast, always run at the speed recommended by the makers.

Preventing Teeth Being Choked

When setting it is quite a good thing to leave a couple of teeth every 8 in. to 12 in. without set, they then act as cleaners and relieve the other teeth from being choked. If your machine has very small wheels (no first-class maker makes less than 24-in. diameter), use saws of thinner gauge—say 22, 19 gauge is best for 30-in. and 36-in. machines.

Hammering Back of Saw if Hollow

Narrow band saws do not require hammering or tensioning like the wide ones used on band mills, but the back of the saw should be straight and if they do get hollow they should be lightly hammered—using a round-faced hammer on both sides near the back edge.

Modern band sawing machines with built-in motors run much faster, the perfect balance of the wheels is more important than ever; the pitch of the teeth should be increased, i.e., less points per inch. Fewer teeth are advisable when cutting thick soft wood.

CHAPTER VII

PLANING AND THICKNESSING MACHINES

NEXT to the rising and falling-table sawbench the combined planing and thicknessing machine is one of the most useful tools to have in the shop. To the man of limited capital, these two are very often the extent of his power-driven machines. Many operations for which firms who work on mass production methods use single purpose machines may be accurately performed on the "over and under planer" (to give it its workshop name).

Capabilities of the Machine

A well-designed machine will do planing out of wind, jointing, bevelling, chamfering, moulding, tongueing, grooving, planing to even thickness, etc., with the use of suitable cutters.

Modern machines are made in various sizes according to the width of timber requiring to be worked; usually capable of thicknessing about 9 in. deep. A popular size is a 20 in. × 9 in.

The pattern in Fig. 90 consists of a main frame. A, usually in one casting with a broad base; inside this works the bottom or thicknessing table B of substantial proportions. This bottom table is fitted with anti-friction rollers, and is controlled by a conveniently placed handwheel at the side of the machine.

The top tables CC are extra long so that accurate planing and jointing can be done, and each table has independent horizontal draw-out motion for easy access to the cutters, and to allow of the use of moulding irons on the cutter-block.

Each table can be raised and lowered by means of a fine screw adjustment to regulate the cut, and is fitted with steel lips to reduce to a minimum the gap over cutters. A long adjustable iron fence D, with quick-acting canting motion, is also included.

The Feed Rollers

The feed rollers to carry the timber through the machine when thicknessing, consist of two powerful steel rollers EE, one being fluted and the other plain, and these are controlled by springs outside the frame, and are easily adjusted to suit light or heavy work. These feed rollers are operated through machine-cut gears by a friction clutch worked by lever F, and so arranged that the feed rollers may be instantly stopped or started independently of the cutter-block.

A Note on Bearings

Bearings of any machine are the most important detail, any trouble or wear in such being reflected on the work. High-speed ball bearings specially designed for this type of machine are now fitted in all modern machines. These bearings are enclosed in dust-proof housings, and require a minimum of power, and will run for several months without attention for lubrication.

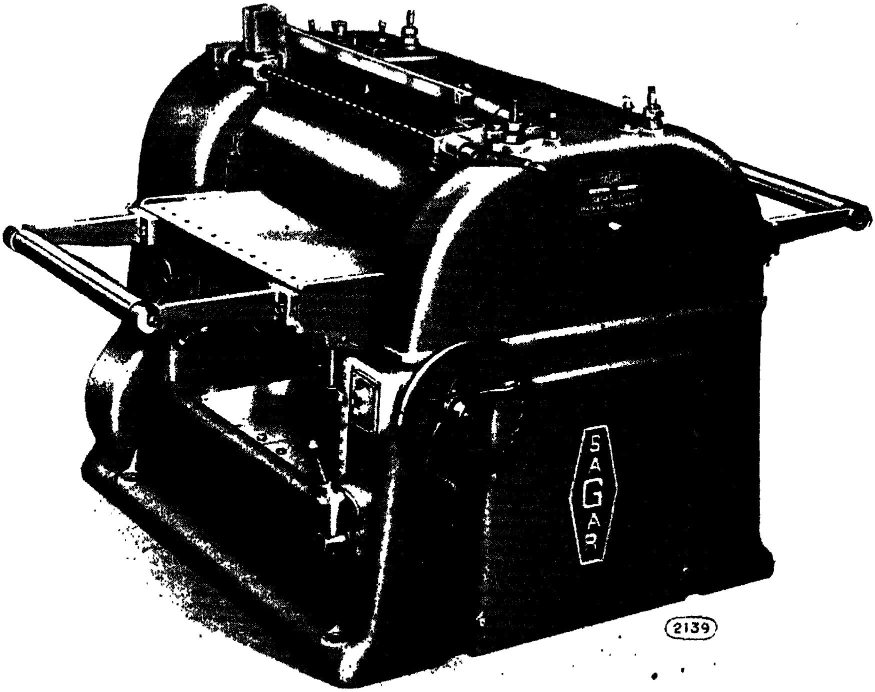

Fig. 90.—A MODERN PLANING AND THICKNESSING MACHINE.

(*J. Sagar and Co. Ltd.*)

The Rebating Table

A rebating table is fitted in front of the machine (readily detachable if desired) and rebating can be done without changing the cutters.

The Cutter-Block

The cutter-block must be of a circular pattern, to comply with the Board of Trade regulations, and is usually arranged to carry moulding irons in such a manner that they may be used without interfering with the ordinary plane irons.

The cutter-block, in its present form, is circular, and called the "safety" block, as distinct from its predecessor the square block, which is a particularly dangerous tool to operate.

In these safety cutter-blocks the cutter is fastened face downwards on to a steel block with two flat sides and two round sides. The planing knives are held in position by clamp-plates screwed or bolted down on to the flat sides of the block; these plates being of such a cross section as to make the whole, when in position, circular. Many of these blocks have the knives parallel with the axis.

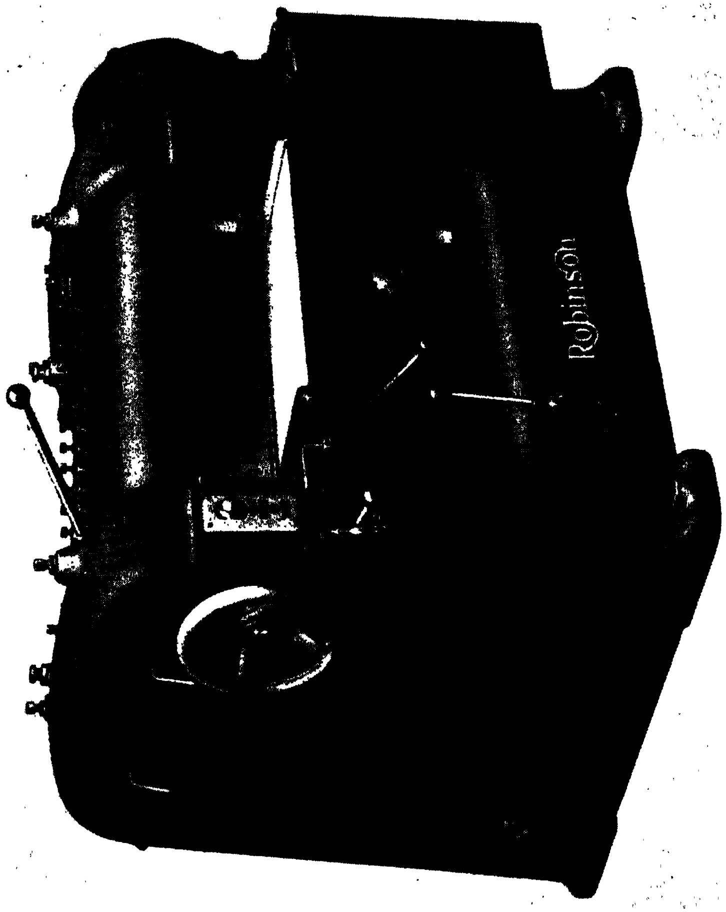

Fig. 91.—Type WE/T Motor Driven Hand Feed Planer and Surfacer.

(Thos. Robinson and Son Ltd.)

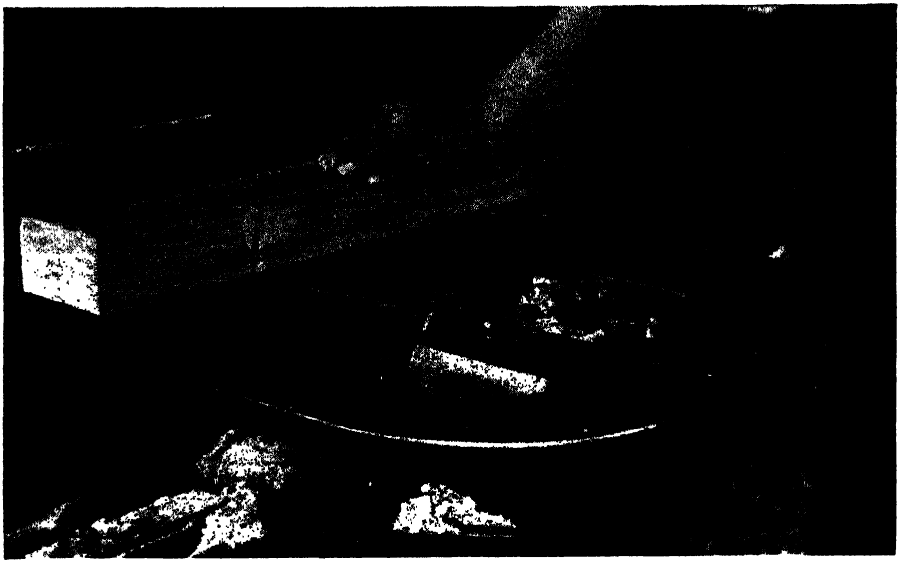

Fig. 92.—Taking Twist out of a Piece of Wood

This is done on the planing or top tables of the planing and thicknessing machine, the front being lowered to take off the shavings. The timber surface, after being passed over the cutters, will lie in one plane, the effect being shown in Fig. 94.

The Skew Cutter-Block

Another type known as the skew cutter-block is so designed that instead of the whole of the cutting edge coming in contact with the wood at once the flat surface of the block is arranged on the taper; usually $\frac{1}{4}$-in. or $\frac{5}{16}$-in. in 24 ins., thus allowing the knife to take a shearing cut across the timber. The cramping plates are, of course, fitted so that the whole is a parallel cylinder.

These plated cutter-blocks are subject to enormous centrifugal forces in which the weight of the knives and the cramping plates is thrown on to the holding screws and bolts.

Some idea of this strain may be gathered from the fact that a weight of 1 lb. revolving at 1,000 revolutions per minute amounts to 85 lb., or at the usual speed of planing machines, viz.:—4,000 r.p.m. equals 1,450 lb.—nearly two thirds of a ton.

Another Type of Cutter-Block

A third type of block (see Fig. 100) takes advantage of this centrifugal force so that the tendency is for the knife to be tightened when the machine is running.

This cutter-block is made in one piece of cylindrical steel with no loose plates bolted on, thus ensuring perfect safety and accurate balance.

The knife is held in position by means of a dovetailed shape wedge.

The wedge is of hard steel, and forms an efficient "back iron" or chip breaker, and obviates the wedging of chips between the block and the knife.

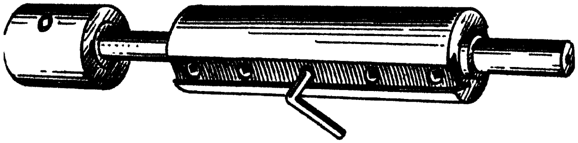

Fig. 93.—SAFETY CIRCULAR CUTTER-BLOCK

This shows a type of cutter-block in which the planing knives are held in position by means of a dovetailed wedge. The wedge is screwed to the block. The spanner used for the screws is shown in position in the above picture.

The screws in the wedge are in compression, not in tension as in the plated type and, therefore, cannot break or pull out when work is in progress.

Most cutter-blocks have a simple arrangement of springs behind the knife, tending to push it outwards against a setting gauge adjusted from the tables.

Fixing Moulding Irons

To enable moulding irons to be fixed in the block, sections of the round side are cut away, and a dovetail groove made. Bolts hold the moulding irons in position. When not in use the bolts hold the sections of plate in position to preserve the balance.

It will be readily understood that only straight mouldings can be worked, although sections with a very slight curve may be attempted.

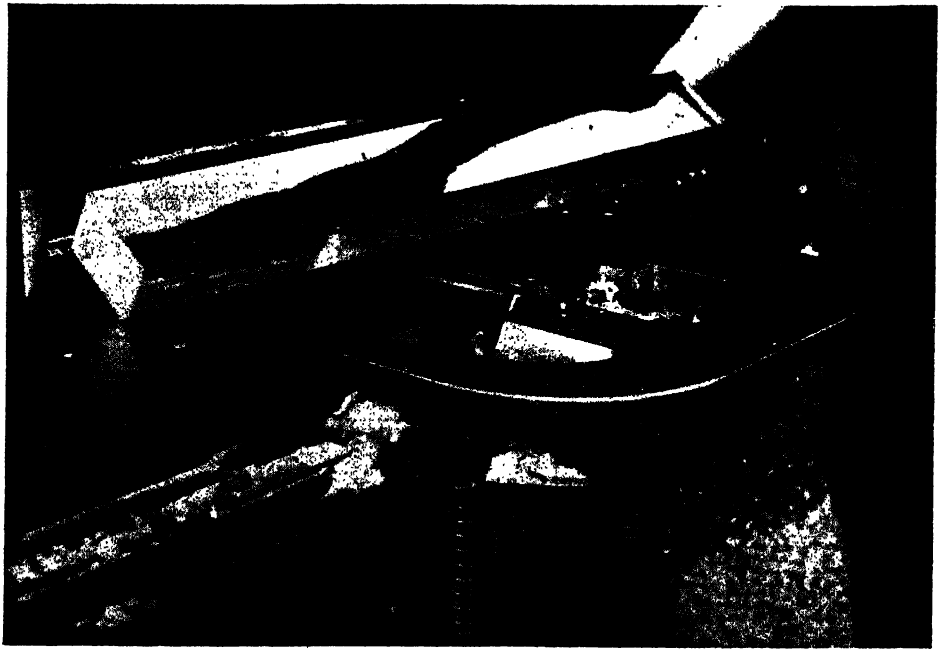

Fig. 94.—SHOWING THE EFFECT AFTER PASSING TIMBER OVER THE CUTTER

This piece of timber has been worked over the top, as in Fig. 92, and has been taken out of twist.

Useful Data on Cutters

The most important part of any machine or tool is the cutter and cutting edge. We may install the finest machines in the world, but if our cutters are not likewise the best obtainable and kept in tip-top condition, the efficiency of the machine is lowered. The majority of safety cutter-blocks carry thin planing irons, usually ⅛-in. thick. These should be of a high-class grade of steel, precision ground to fine limits ± 001-in. (a thousandth of an inch) thus ensuring perfect balance, safety, and a finely finished surface on the timber.

Suitable Angles on Cutters

Theoretically, the amount of bevel on the cutting edge should be determined by the class of timber to be planed; it is of course, unwise to be altering the angle for every different wood, but an extra pair of knives may be obtained, and the one pair kept for hardwoods, the other for soft.

Practice has proved that the angles given in Fig. 99 will work to the best advantage. "A" for softwoods, red and white pine, spruce, etc.; "B" for hardwoods, oak, ash, beech, etc.

The grinding angle must not be confused with the cutting angle. The first only affects the strength of the cutting edge, it does not make any difference to the finish of the work.

The cutting angle is the angle at which the cutters contact the wood. It is

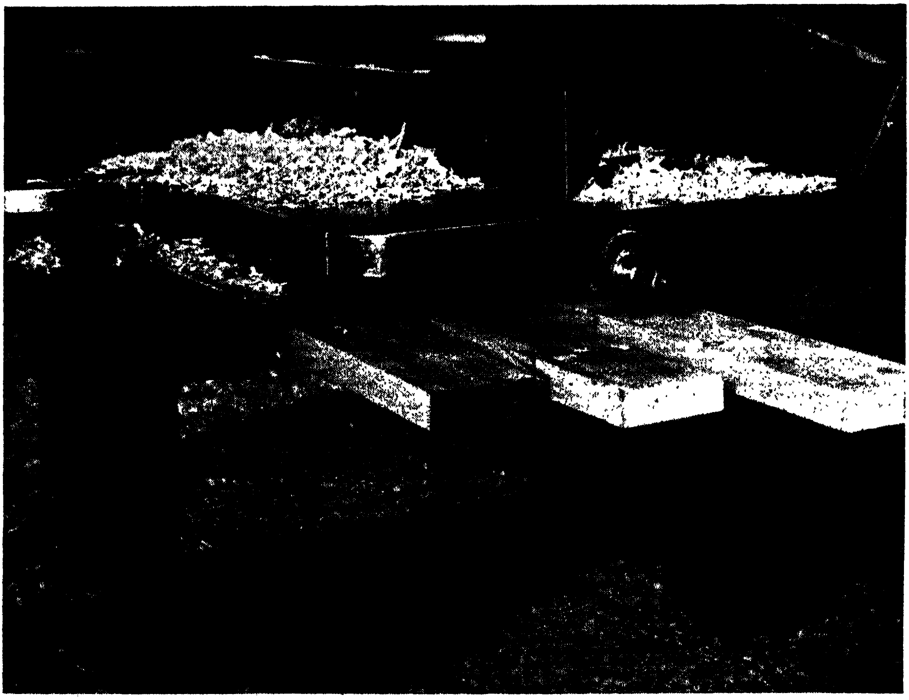

Fig. 95.—WORK ON THE THICKNESSING TABLE—THICKNESSING DOOR STILES

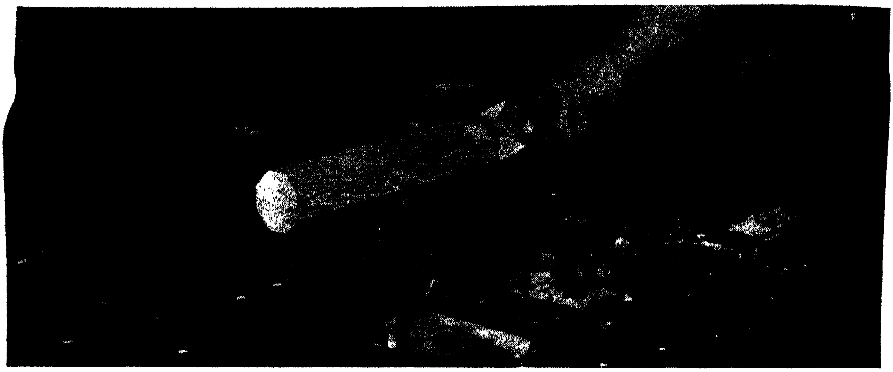

Fig. 96.—TYPICAL EXAMPLE OF BEVELLING
Showing the use of the fence when canted.

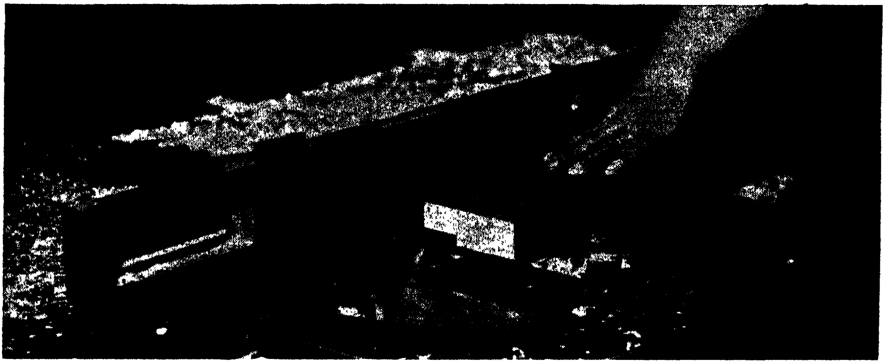

Fig. 97.—REBATING FOR DOOR CASING
This is carried out on the front end of the cutter-block. The front table is lowered to the depth of the rebate. When working the weight of the timber is carried on the rebating table, as shown.

Fig. 98.—FORMING REBATE AND MOULD FOR DOOR FRAMES
Moulding irons are shown bolted to the cutter-block. Gap between top two tables is widened to enable cutters to revolve.

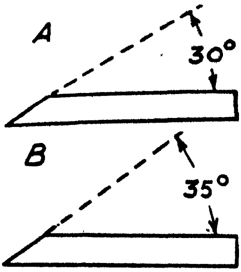

Fig. 99.—Suitable Grinding Angles on Knife

A, for soft woods.
B, for hard woods.

not generally known that cabinet makers' hand planes have the cutters at a steeper angle than do joiners' planes, because cabinet makers more often work in hardwood.

It is not practicable to alter the seating of the cutters on a planing machine, or to change cutter blocks when some extra hard or curly grained timber has to be planed, but one can "back bevel" the cutters, i.e., grind a slight bevel on the face (flat) side 10 degrees (or more in extreme cases) cutters so treated being kept for this purpose. When using these cutters the slow feed should be used, in fact, they will not take a fast feed and they take more power.

Back bevelling is not a recent discovery, the writer has some old moulding planes and some of the irons are back bevelled.

Planing knives may be hollow ground, provided the bevel is short and a fairly large diameter grinding wheel is used. Hollow ground knives take less honing and do not require grinding so often.

Modern thicknessers usually have a gear box giving three rates of speed for the feed. This is so handy that there is no excuse for not using it, badly finished stuff rushed through at top speed will only take more time on the sander, and will then not be as good as it could have been.

The Importance of Balance

In a previous paragraph the importance of balance was stressed. All reputable builders of woodworking machines, particularly in these days of ball bearings, pay great attention to balance, but once the machine has left the factory for its permanent home, the responsibility of keeping the knives in proper balance is in the hands of the operator himself Whilst the weight of the thin knives does not amount to much, even on a wide machine, the effect of centrifugal strain is so great that some few words on this subject are imperative.

The higher the speed the greater the danger. Unbalanced knives can be detected as soon as the machine attains any speed. Excessive vibration is set up which will soon heat up the bearings, and no amount of lubrication will correct the trouble. In the wider machines this causes the spindle to spring the heavier knife, being the one to do the cutting, and a good finish is impossible. Because two knives weigh and look alike (parcitularly if they are wider at one end than the other) it does not prove they are in balance.

A pair of balancing scales is essential if good smooth work is required. An adjustable width gauge is also very useful. Find the lighter knife, and use this for a standard; then work the other down to it, taking care to see the edge is parallel with the back.

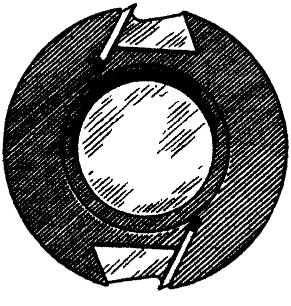

Fig. 100.—Method of Holding Knives in Cutter Block

By means of wedges which are screwed on to the block.

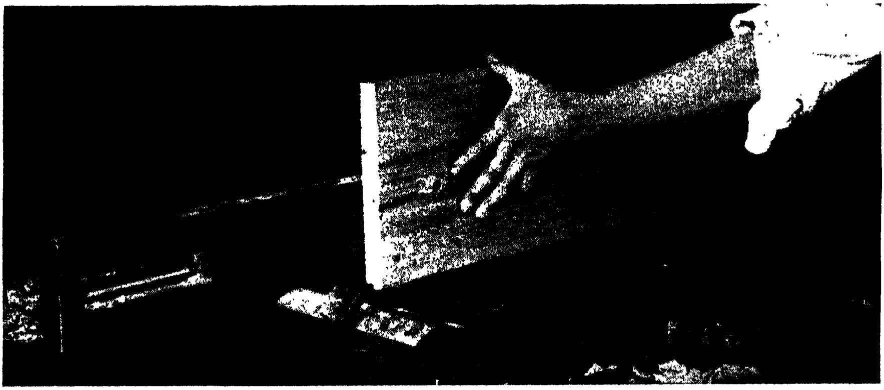

Fig. 101.—NOSING STAIR TREAD
Using the requisite moulding cutters fixed to cutter-block.

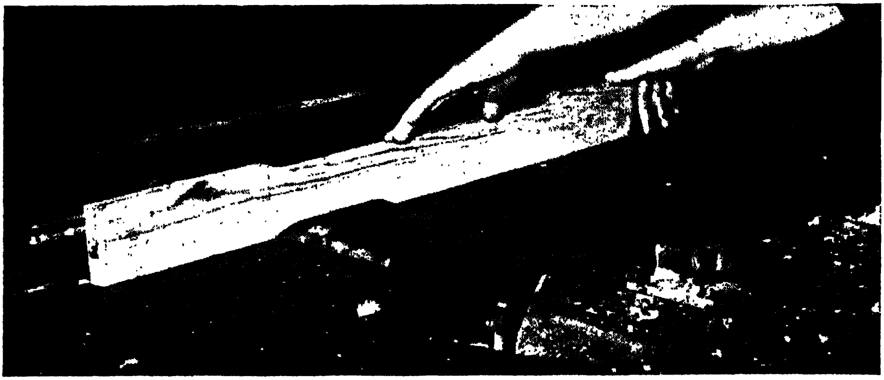

Fig. 102.—SHAPING A BALUSTER
Stop chamfering is done in the same way but with a canted fence.

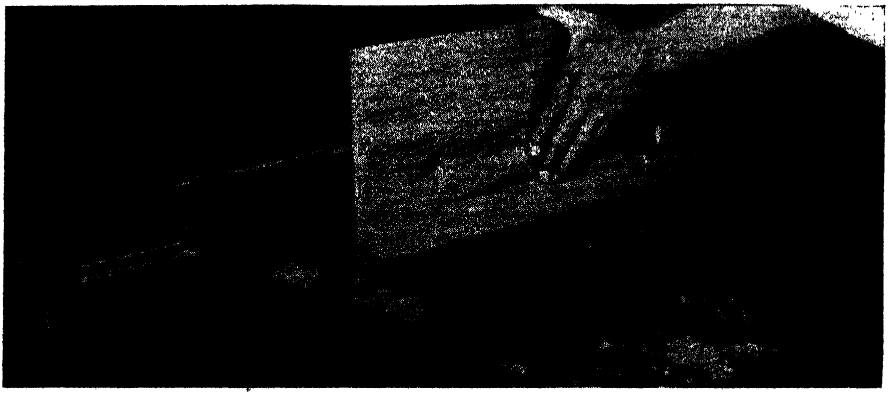

***Fig.* 103.—TONGUEING FOR JOINING WIDE BOARDS**

Once the knives are in balance, if care is taken that the same amount is ground off each, they will not require rebalancing.

Precision Grinding

The precision grinding is important owing to the fact that, should the clamping plates or wedge not fit all along the length, several dangerous effects may arise, chief of which would be the tendency for the knife to "creep" out of its fastening, with disastrous results.

Operation

Having dealt with the machine and cutters, we come to the operating process. Having set the knives true with the top back table, the front table is lowered to take off the shavings.

Taking Timber Stock out of Twist

The function of the top table is quite different from the bottom table.

When working over the top the object is to take the timber stock out of twist, which means that the machined surface, after being passed over the cutters, will lie in one plane. To bring the stock to equal thickness this surface is next laid on the face of the under table, and the cutters clean up the other side.

It is, however, useless to try to bring timber out of twist underneath the machine. The feed rollers and pressures will press the work on to the table whilst it is being machined, but it will spring back into twist on being released from this influence.

A board warped as shown at A, Fig. 104, will come from the top tables as shown at B, Fig. 104, but if passed under the cutters the twist would still be the same in spite of the fact that some wood had been removed as at C, Fig. 104.

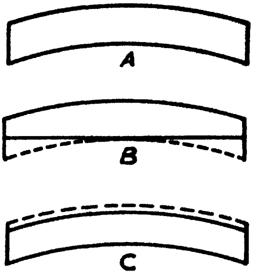

Fig. 104.—SHOWING EFFECT OF TRYING TO BRING TIMBER OUT OF TWIST ON TOP AND BOTTOM TABLES

The warped board, A, planed on top table B, But on bottom table the effect is simply as shown at C.

Fig. 105.—MOULDING HANDRAIL

Use of the Canting Fence

The canting fence for square or angular

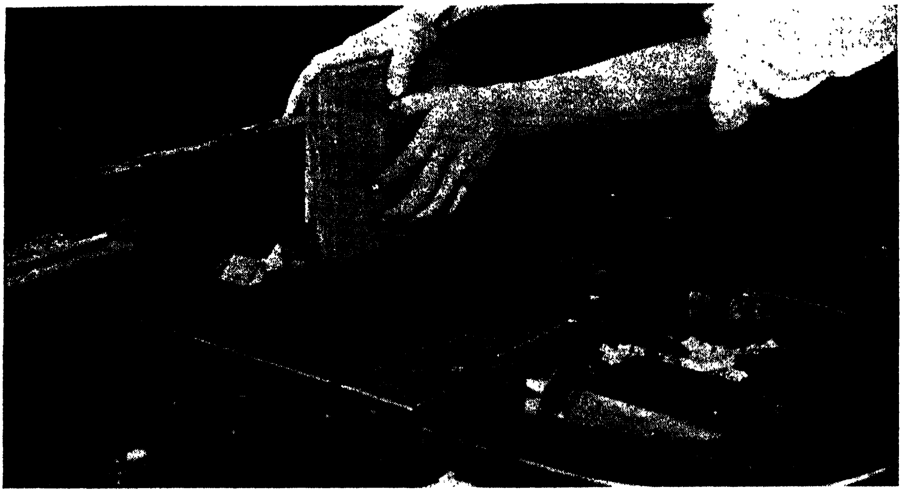

Fig. 106.—MOULDING NEWEL CAP

Note the plate bridging the gap between the tables. It is advisable to use this when small stuff, like that shown, is to be worked.

work is usually placed on the front top table, the end overlapping the other table, this being provided with an adjustable sliding piece which compensates for the difference in height of the two tables depending on the amount of cut being taken off. The fence is made adjustable across the full width of the machine, so that the sharpened edge of the knives may be used up inches at a time. When working narrow stuff it also prevents the tables being worn all in one place.

How to Use the Machine for Squaring-up Timber

When squaring-up timber, one face is first of all taken out of twist, and a pencil mark put on. This is then held up against the fence until the side underneath is cleaned up. When all the pieces to be worked have been done on these two sides they are then reversed and passed under the cutter-block on the bottom table. The thickness is adjusted to the requirements of the job in hand.

Rebating

Rebating is done on the front end of the cutter-block, the fence fixed to the width required, and the front table lowered to the depth to be taken out; the weight of the timber resting on the rebating table bolted on the side of the machine (Fig. 97).

Instead of the rebating table some machines have the in-feed table made 2-3 in. wider, extending in front of the out-feed table. This supports the timber being rebated.

Stop Chamfering, Moulding and Tongueing and Grooving

To set the machine for stop chamfering, both tables are lowered to the required depth of cut. They will, therefore, be on the same level, the cutter-block projecting through the gap. The fence must be fixed to the required angle, and the timber lowered carefully until it rests upon the tables. It can then be moved forward to the required length of chamfer.

When moulding is to be worked, the moulding irons of the section required are bolted on the cutter-block, after the loose segments, making up the circular block, have been removed. The tables are withdrawn horizontally to enable the irons to revolve. Both tables are set an equal height, just sufficient to give the depth of cut required. The position of the fence, of course, determines the mould, being parallel to the other edge of the board.

Tongueing and grooving is done in a like manner, suitable cutters being used.

Adjustments of Rollers and Pressure Bars

A new machine from a reputable maker, will have been tested and all adjustments made ready for work. Do not therefore interfere with the adjustments unnecessarily, the machine should do a lot of work before requiring such attention. All that may be needed will be more pressure on the roller.

For the feed rollers and pressure bars the rule to work to is minimum lift and pressure as required.

Careful study of Fig. 108 should enable you to set all rollers and pressure bars. The basic line is the cutting circle, so that if the cutters when replaced after grinding are given a greater or less projection from the cutter block, the

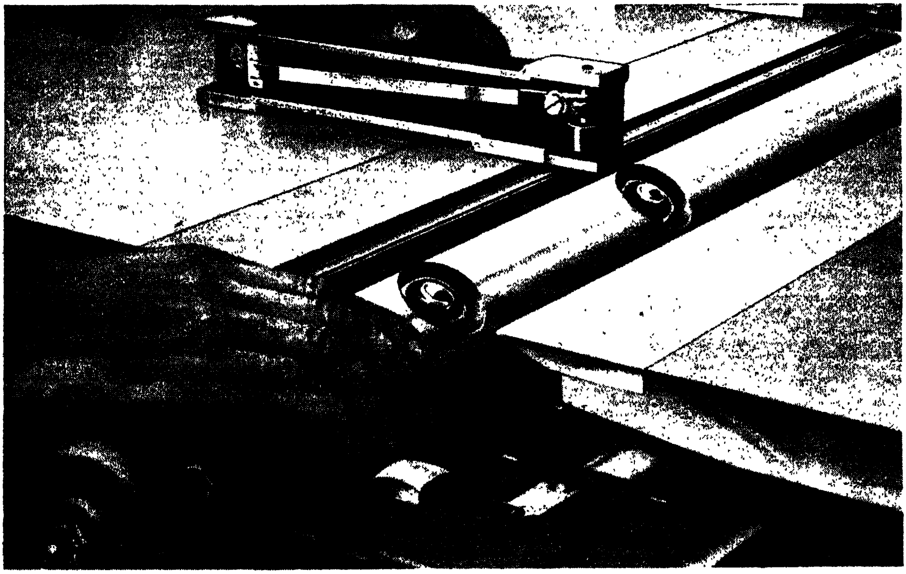

Fig. 107.—Knife Setting Device

The best results are always obtained when the knives are set so that the cutting edge revolves in exactly the same plane. The tool illustrated enables this to be done correctly. The T-shaped straightedge is provided at one end with a plunger connected to the short end of a lever. The pointer on the other end gives the degree of accuracy between the setting of the two knives. Should the pointer show a difference the receding knife is adjusted to agree with the position of its fellow.

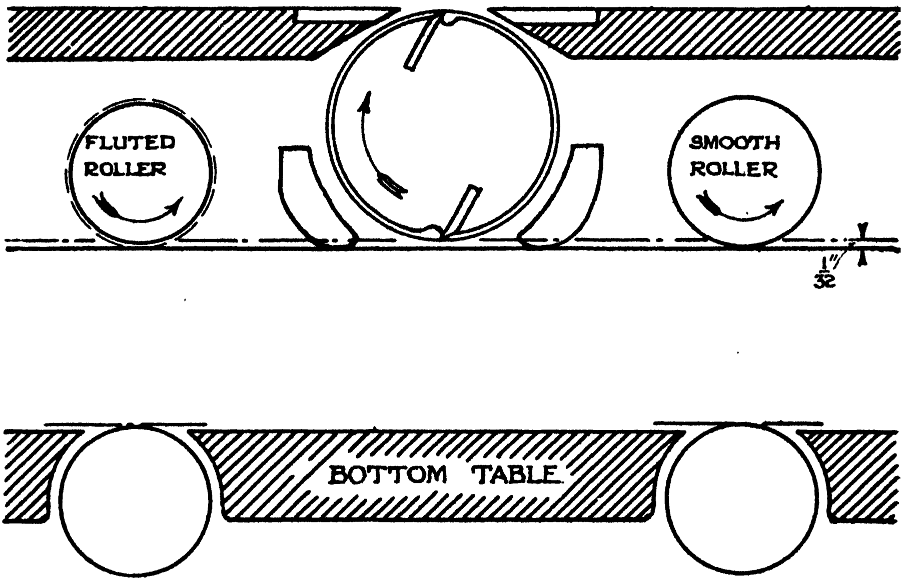

Fig. 108.—Adjustment of Rollers and Pressure Bars in Relation to Cutters

whole scheme "falls to bits," also the gauge for setting the thicknessing table to plane a given thickness will be wrong.

For the inexperienced operator, I will explain. Suppose the cutters are given $\frac{1}{16}$ in. more projection than previously, they will take off $\frac{1}{16}$ in. more than the table is set for. The fluted roller will still get a grip because it deals with the unplaned timber, but when the timber reaches the smooth roller, it will pass under it and the roller will not help to pull it through. When the last end has passed the fluted roller the wood will stop. If your machine has setting gauges use them and if not, before removing the cutters from the block, carefully set the back table to the cutting circle. You can then set the new, or re-ground cutters to the table.

In Fig. 108 the two feed rollers are set $\frac{1}{32}$ in. below the cutting circle, and the two pressure bars $\frac{1}{32}$ in. below the cutting circle. These dimensions are called the "lift," the amount of "lift" being determined by set screws which stop the rollers and bars dropping any lower.

To test the setting, take a cut off a fairly wide piece of timber, then without altering the thicknessing table, pass the same piece through again and as it travels watch or feel how much the roller bearing blocks and pressure bars lift, and correct if necessary.

The anti-friction rollers in the bottom table must be set as fine as practicable, a few thousandths above the surface of the table. They are easily tested by holding a straight rule across, be sure all the four ends are alike.

Hard dry timber will feed with very little help from the bottom rollers; but for soft wet timber, or rough stuff which has not been surfaced on the other side, the rollers will need raising a little. For some years the best thicknessers have been fitted with a device for raising both rollers simultaneously; a turn or two of a small hand wheel on the in-feed end of the bottom table while working, effects this and when the job is finished the hand wheel restores the rollers to their normal setting.

To find the cause of faults in the planing requires experience, a few tips might be helpful: if when the cutters have just started cutting the wood hesitates in its travel, it may be the second pressure bar is too low or the springs are too tight; if there are dips at the finishing end the first pressure bar may not be tight enough. Do not alter the lift of bars or rollers until the bottom rollers have been examined; they may be covered with resin and chips. If there are marks or dips at either end of a planed piece measure how far they are from the end, this will give a clue to the cause, as the wood leaves the fluted roller or as it leaves the first pressure bar.

Long pieces of especially heavy stuff must have the end supported.

Wear on the bottom table slides on an old machine will cause trouble, allowing the table to tilt as the weight of the wood passes from one side to the other in its travel through the machine.

Means for adjustment are usually provided.

CHAPTER VIII

SAW BENCHES

FOR all small work where a number of pieces have to be machined on a saw bench, the moving table scheme is to be recommended as a means of solving many difficulties in the rapid production of work, especially where a spindle is not available.

Suitable Types of Saw Bench for the Travelling Table

Before illustrating the variety of jobs that can be accomplished with this apparatus, a few notes as to the type of saw bench to which it is most applicable must be considered.

Rising and Falling Saw

In the first place it is essential to the usefulness of the travelling table that the bench is provided with means for the rising and falling of the saw, so that depth cuts and slots can be machined. An iron saw bench is the more suitable tool as it is possible to obtain the greatest depth of cut with a given diameter of saw, although a wooden topped bench can be utilised within certain limits.

The versatility of the device depends on how close the surface of the travelling table can be placed to that of the ordinary bench, and also to the use of wood for the travelling table. A wooden table is utilised because of the ease with which fixed fences or jigging strips can be attached to the bench for the purpose of holding the work while it is travelling past the saw. Another requirement is that the moving table should move quite easily, and further, that it should automatically return to the normal position when the cut has been made.

Removable Table Fitting

In the small shop which has a saw bench with a saw of 12-in. or 14-in. diameter and an iron bench, the moving table can be a removable fitting of, say, 1 in. or 1⅛ in. finished thickness. The table runs on rails fixed to the sides of the main bench, placed low down so as to obtain roller wheels of the largest possible diameter.

Fixing Travelling Rails

The rails should be of $\frac{5}{16}$-in. by 1¼-in. section, "veed" on the top edge, which, by the way, should be perfectly straight in both side and end elevations. When fixed, there should be no top "surface wind," otherwise the table will rock on three wheels, at various points in its travel.

It may be necessary to fit the rails in two parts on the pulley side of the saw spindle, as indicated in the sketch, Fig. 111, but this and other details must be determined with special reference to the particular machine being fitted up.

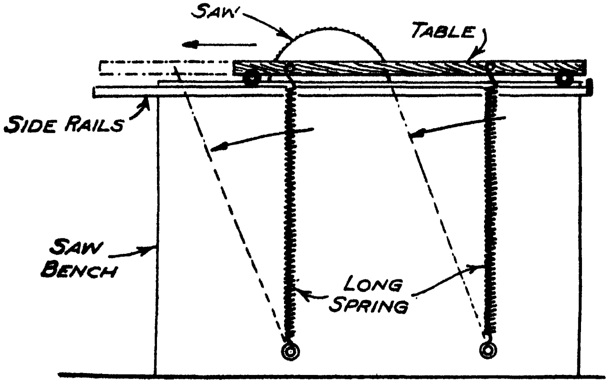

Fig. 109.—MOVING TABLE ATTACHMENT FOR SAW BENCH
Showing the spring return motion.

Fixing the Rollers to Table

To keep the rollers clean, they should be let into the underside of the moving table, the necessary slot (if any) being covered by a piece of brass plate, as indicated in the general arrangement drawing of the table attachment, Fig. 109. The rails may require to be extended beyond the front and rear limits of the fixed table to give a greater stability to the travelling top.

Wood for Table

The two tables should clear by at least ⅓ in. The travelling one must be prevented from warping, and it must have a rather long saw slot—this depending for its length on the desired stroke and the size of the saw. The best construction is obtained by fitting a ledged, built-up board inside an angle-iron frame of 1-in. or 1¼-in. stuff, welded up at the corners. This frame, before fitting the wood filling, must be finished off without a suspicion of any cross wind in its top surface. It should also be drilled for alternate top and side countersunk screws.

The wooden table will have to be rebated for the angle to obtain the finish

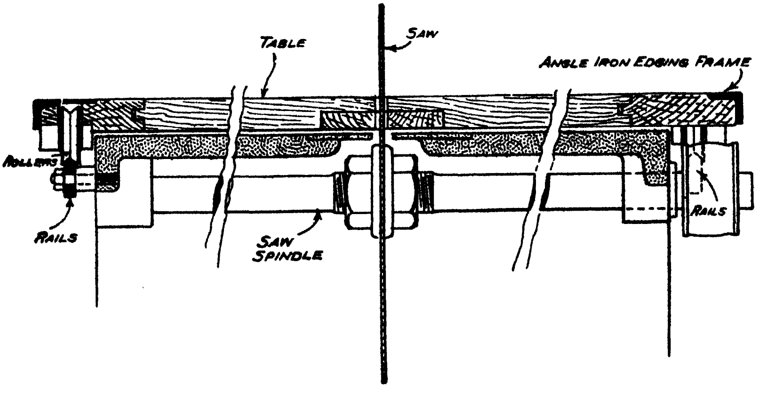

Fig. 110.—CROSS SECTION THROUGH SAW BENCH FITTED WITH TRAVELLING UPPER TABLE

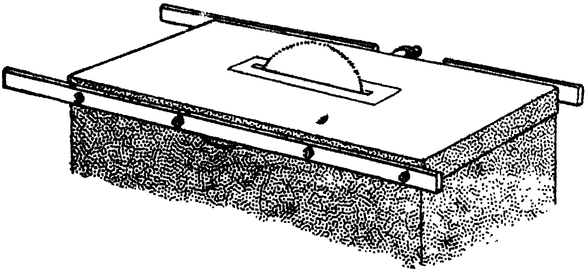

Fig. 111.—RUNNERS FIXED TO SIDE OF SAW BENCH

indicated in the sketch, Fig. 113. The table may be made of glued-up planks, tongued and grooved into end battens, and with a 4-in. strip let in to the under surface at the saw slot. The other alternative is to use a five-ply board of a suitable material and thickness.

Fitting Bearings to Table

The bearings for the "Vee" roller wheels may be fixed to the wood or to the angle frame. This and other details are matters which must be settled by the mechanic making the frame for any particular machine.

Attaching the Springs

To hold the table down and at the same time to give it the automatic return traverse, two long springs attached to the table and the frame of the saw bench are fitted, as shown in Fig. 109. The springs should be made readily removable by having hooked ends fitted over suitable studs, as indicated. The travelling table may then be fitted over the saw or taken adrift again in a few moments, the side rails left remaining when the saw bench is being used in the ordinary way and with the ordinary fences.

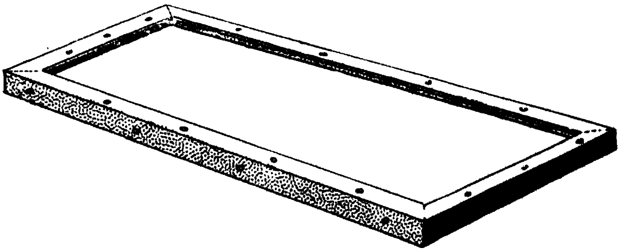

*Fig.*112.—ANGLE-IRON FRAME FOR CARRYING WOODEN TRAVELLING TABLE

OPERATING THE TABLE

The illustrations, Fig. 118 (*a*, *b* and *c*), illustrate a few typical jobs that can be accomplished quite easily on a travelling table saw. For that at *a*—cutting to length at any predetermined angle—the jig required is a couple of wooden

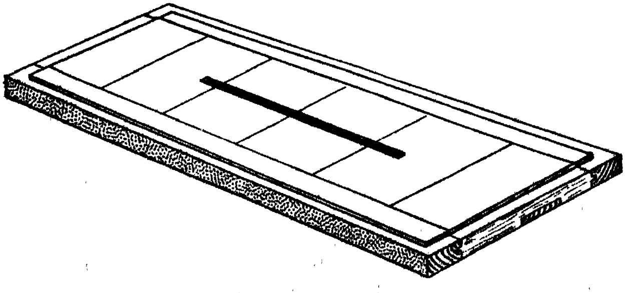

Fig. 113.—THE BUILT-UP WOOD TABLE

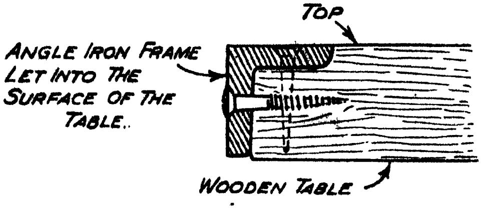

Fig. 114.—SECTION OF EDGE OF TABLE

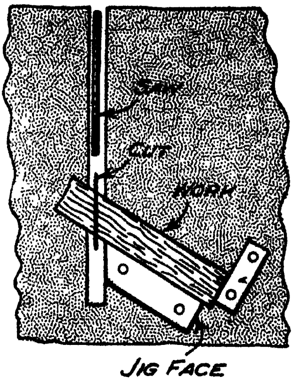

Fig. 115.—JIG FIXTURES FOR CUTTING PIECES TO A PREDETERMINED ANGLE

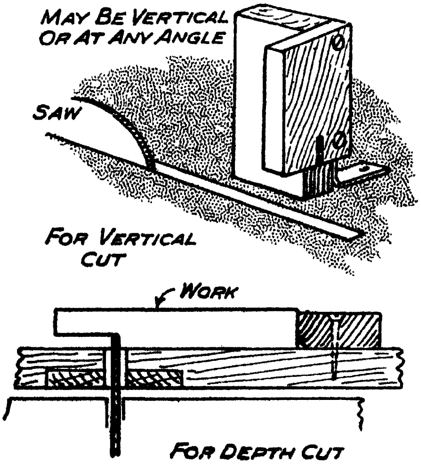

Fig. 116.—TWO JIG FIXTURES FOR MAKING HALF-LAP JOINT

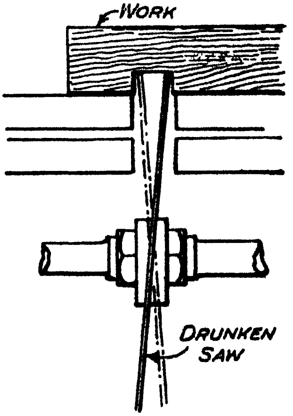

Fig. 117.—DRUNKEN SAW FOR GROOVING.

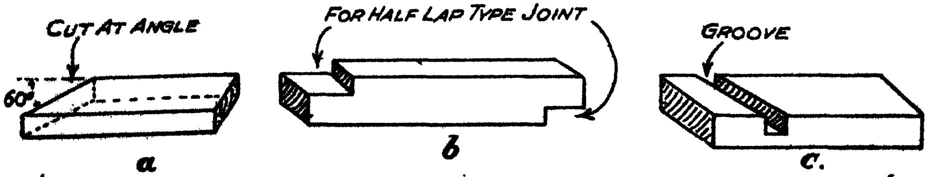

Fig. 118.—THREE SIMPLE JOBS THAT CAN BE DONE IN QUANTITIES WITH ABSOLUTE INTERCHANGEABILITY strips screwed down to the surface of the table, as sketched in Fig. 115.

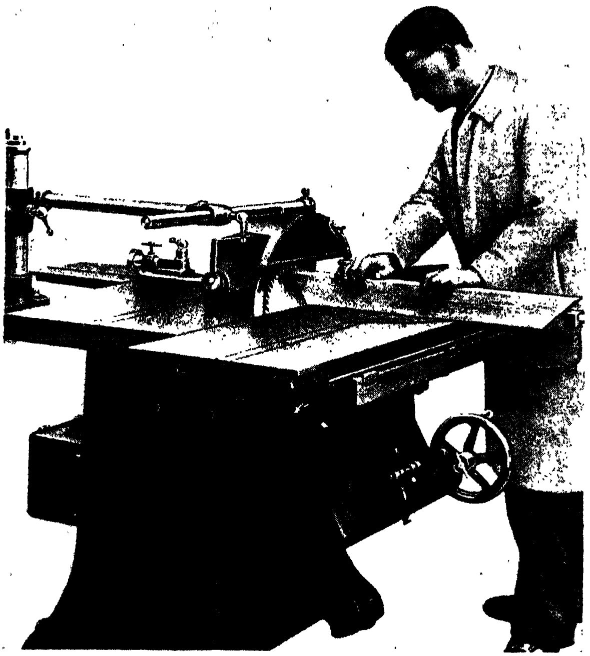

Fig. 119.—A WADKIN SAW BENCH INCORPORATING A SLIDING TABLE

Half-lap Joint

For the half-lap joint type of cut the first process would be to saw one end square—or at an angle, if required—the battens being already in the approximate finished lengths. Then make the "on-end" cut, a vertical fence being fitted up on the moving table, as illustrated in Fig. 116. In this case greater accuracy is maintained by keeping the fence just clear of the bench face at the bottom edge of the jig. Blind corners, which tend to fill with sawdust are at all times to be avoided. The next operation, after the piece is cut to length, is to make the depth cut to remove the wood partly sawn off by the first jig and from the "half-lap" rebate. The work can be done at right-angles, as shown, or at any simple or compound angle.

For grooving, as at *c*, Fig. 118, a drunken saw can be used and slots obtained at any length within the limits of the table travel, at any angle, as indicated in the sketch, Fig. 117. As a rule, for parts of which a hundred or more will be required to interchangeable sizes, a travelling table of this kind will be found invaluable.

The illustration, Fig. 119, is of particular interest in that it shows a manufacturer's job of a sliding table on a saw bench. This is an electric driven canting spindle dimension saw. The saw, which is mounted direct on the motor shaft, cants up to 45 degrees, and the table remains always in the horizontal position.

The saw also has rise and fall movement for convenience in rebating, trenching and grooving.

The table is divided into two parts. The front table slides past the saw on ball bearings and has a movement away from the saw for taking trenching heads. The back portion of the table is stationary. The front table is marked out in degrees for convenience in setting the fences for angular cutting.

The cutting off fence operates on a steel bar sliding in machined ways on the able surface. It is indexed and arranged to swivel either right or left hand. An adjustable stop and rod are provided for cutting off dead to length.

CHAPTER IX

TENONING MACHINES

THE mortise and tenon joint is one of the basic principles of good joinery. To make this joint by hand calls for skill and care, but with a good rip saw and tenon saw, both carefully sharpened, tenoning should not be a hard job. It is the squaring over and gauging which takes so much time; tenoning tools have been tried on the old hand mortiser, but the circular saw is more successful. Both the circular saw and the bandsaw must be in perfect condition; the spindle moulder attachment is the best substitute.

To possess a real tenoning machine is the ambition of many a good joiner, but the cost and the space required is often the difficulty. Machine-makers in recent years have realized these facts and several smaller machines have been placed on the market. The large machine taking timber 24 in. wide and cutting 6 in. long tenons at a stroke is necessary for big contractors building banks, universities and civic halls, etc.

The machine illustrated in these pages only occupies a floor space of 5 ft. 6 ins. square, it will work timber 14 in. wide ×5 in. thick, cut tenon 4½ in. long and 6 in. long by taking a second stroke, will if desired, scribe one or both shoulders.

Motorised cutter heads save a lot of space as no countershaft or belting is required.

Each head has its own "start" button, and a brass master "stop" knob cuts the current from all motors simultaneously. A half turn to the right while the knob is depressed "locks out" all the start buttons, a valuable safety feature, preventing accidental starting during setting up, sharpening or adjusting operations. Each tenoning head and each scribing head has both vertical and lateral adjustment. All slides have locking screws which must be released before moving the heads.

Locking pins are provided for all spindles to secure them when setting or sharpening cutters or removing cutter blocks. Each spindle can be locked in two positions, so that each pair of cutters can be sharpened in a convenient position.

The tenoning heads are set to give a slight undercut to the shoulders.

The tenoning cutters need not be removed from the blocks except for grinding, they can be honed in position and if slightly hollow ground, will last a long time.

To Operate

Screw a backing piece of wood to the steel fence, about ⅝-in.×2-in., or as deep as the timber to be worked, long enough to project 2 or 3 inches over each end. This not only backs up the work and prevents spelching, but for small quantities and odd lengths, it enables the shoulder marks on the stock to be exactly positioned by the shoulders cut on the backing piece.

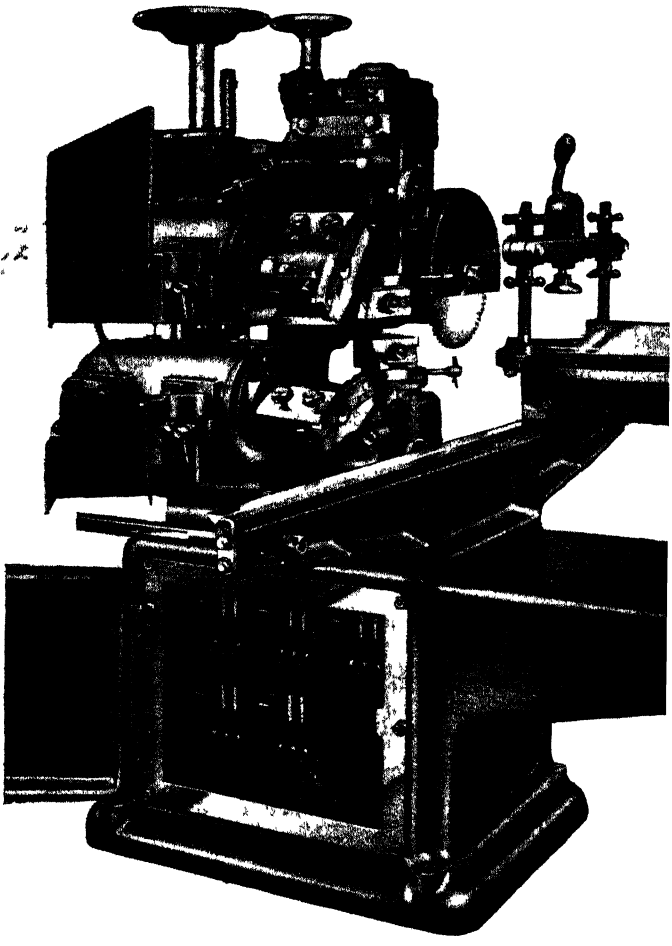

Fig. 120.—Beltless Motorised Tenoning Machine "TBA"
(*Wilson Bros. Ltd.*)

For stock jobs likely to recur, save these backing pieces, they are useful to set to, especially for scribing cutters.

Setting the Tenon Heads

The provision of graduated rules and pointers together with individual or simultaneous vertical adjustment of the tenon heads, makes setting easier.

The large hand wheel on the top of the machine pillar is interchangeable on the two spindles. The bottom tenon head is raised or lowered with the large hand wheel on the right hand spindle. With the wheel on the left hand spindle, both heads are raised or lowered together. Suppose a half-inch thick tenon is required ⅝-in. from the face (face side down on the table) slacken the screws which lock the slides half a turn, and with the wheel on the left hand spindle, raise both heads until the top vertical pointer reads 1⅛-in., i.e., ½-in. + ⅝-in. =1⅛-in. Transfer wheel to other spindle and adjust head until bottom vertical pointer reads ⅝-in.

If equal shoulders are required adjust both heads until pointers on horizontal rules read zero. For unequal shoulders move one head until the difference required in lengths of shoulders is shown on the two rules.

Set and secure the guards and cut a trial short tenon and test in mortise.

If tenon is slack lower bottom head, if too tight raise bottom head, using the right hand spindle for this adjustment. Cut another inch and test again.

When tenon fit is satisfactory, see if face of rail is flush with face of stile. If rail stands proud of stile lower both heads and test again.

Setting for Scribing

It is essential that fit of tenon is first obtained before setting the scribers, because the scribing heads move with their respective tenon heads, each scribing head having independent horizontal and vertical adjustments.

After "locking-out" the motors, mark the shape and depth of the scribe on back edge, away from fence, of trial tenon and adjust scribing heads until tenon will just pass between them. Working from the rear of the machine, fix a pair of cutters (with double thickness of brown paper between cutter and block) on opposite sides of bottom block, flush with the top edges of the block, but with the cutting end of the cutter *slightly* tilted upwards to prevent the cutter edge rubbing the face of the tenon.

The cutters strike the timber at an angle. To set them correctly, draw the table forward until the edge of the timber is in line with the centre of the spindle, turn the spindle and adjust the cutter until the point coincides with the depth

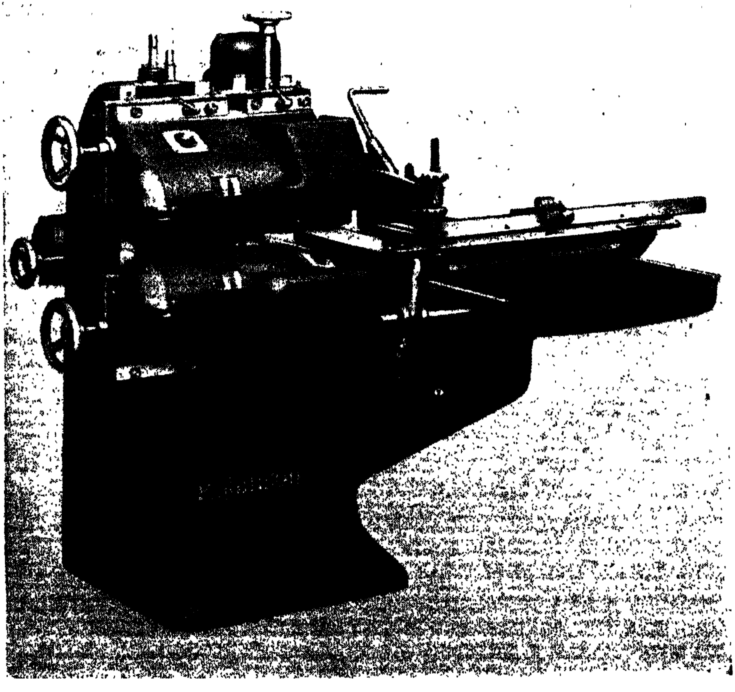

Fig. 121.—Type RP/E Electric Tenoner.

(Thos. Robinson and Son Ltd.)

of the scribe. Set both cutters exactly alike. The top head is set in similar manner.

When ordering scribing cutters remember that those for the bottom head are opposite hand to those for top head.

When a scribe involves a deep heavy cut or the wood is very hard, two pairs of cutters may be used on the four sides of the block.

If the mould has several members, as, for instance, an ovolo near the face and a scotia towards the rebate, have a pair of cutters for each member, they will work sweeter and are easier to sharpen—elaborate cutters are difficult to sharpen and retain their shape—whereas simple cutters will often come in for other jobs or can be adapted.

Good class work should be tenoned and scribed in the square and moulded afterwards, thus removing any spelching which is unavoidable in some kinds of timber.

If prepared sections have to be scribed, make a hardwood saddle to fit the mould and fix it to the fence backing piece this will obviate spelching.

Setting the Stops

It is only necessary to mark the shoulders on one side or edge of the first piece for each length required. Place a marked rail in position on the table, the shoulder mark in line with the shoulder already cut on the backing piece. Cramp up and adjust the dead stop to the end of the rail and cut tenon (and scribe) Turn rail end for end keeping the face down, cramp in position with shoulder mark as before. Slide and secure the spring disappearing stop to the shoulder already cut.

The machine cuts 4½-in. long tenons at one stroke, 6-in. long by moving rail forward and taking another stroke, the dead stop would be set for the second stroke.

Multiple End and Shoulder Stops

These enable a number of sash bars, narrow rails, etc., to be worked at one stroke. The arrangement provides a flat steel bar as a dead stop for cutting the first shoulder, and a square bar pivoted eccentrically as a disappearing stop for cutting the second shoulder. In this instance both dead and length stops are at the back end, away from the cutters. After cutting the first shoulder, the disappearing stop is turned up, the material recramped with the already cut shoulder up to the stop. These stops are clearly shown in Fig. 122, the second shoulder is about to be cut.

Double Tenons

Double tenons on the lock rails of doors, not an everyday job, but when they are specified it is often with stiles 5-in. to 6-in. wide—they cannot be cut on this machine, but large tenoners frequently have an extra spindle in addition to the two scribers, for this purpose.

This machine will, however, cut double tenons 3½-in. deep, so that meeting rails for sliding sashes, transomes which project in front of the jambs of casement frames can be worked. A drunken saw on one of the scribing spindles is easily set for any width from ⅛-in. upwards. A Whitehill cutter head is suitable for big widths, minimum ¾-in. If both shoulders are being scribed the double tenons will require a separate operation.

Bevelled Shoulders

The fence is adjustable both ways to 45° enabling bevelled shoulders in doors, frames, screens, spandril framing, dado framing on stairs, soffit frames, etc., to be worked. Stair strings can be tenoned too, the outer end being supported. If the stock is accurately thicknessed and the tenon central it can be turned over and both ends tenoned with one setting of the fence.

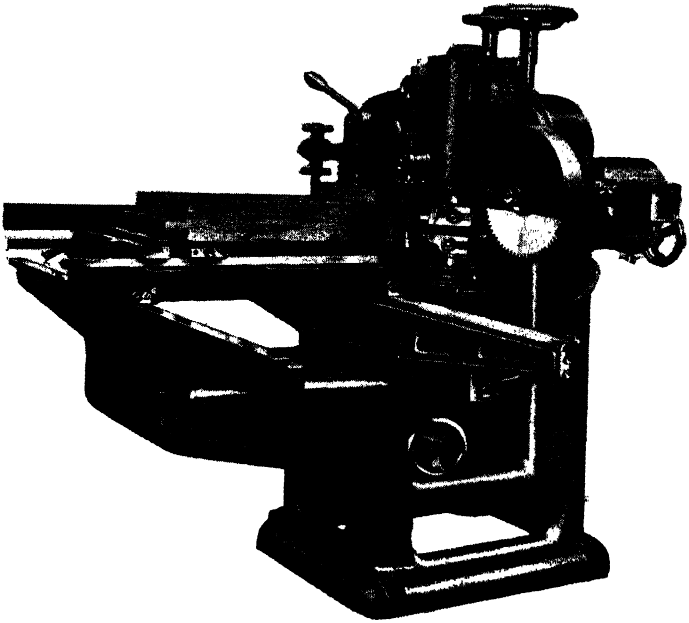

Fig. 122.—Rear View shows Multiple Stop in use (*Wilson Bros. Ltd.*)

When possible always work bevelled shoulders with the long point to the fence (on your left) especially if the shoulders have to be scribed. The cutters are then working partly with the grain. The more they are bevelled the more important this is.

Circular Saw Unit

The saw has horizontal adjustment only. A hollow ground saw is usually supplied, which if kept sharp leaves a clean planed finish. Tenons either through or "stump" can be cut to exact finished length at same operation as tenoning and scribing.

Moulding or Square Turning

A suitable cutter block and cutters fitted to the top tenoning spindle, will mould the ends of newels or shape the horns (or lugs as they are called in the north) of sash stiles (sliding sash or "box frame" windows will probably come back as they are more suited to our climate). Fill the table to capacity and use a hardwood backing piece. When machining a number of pieces at one operation, screw a strong piece of wood to the cramp shoe. Make it hollow end to end so that the outer pieces will be held. A light sash cramp is helpful with sash stiles. Casing heads, pulley stile heads and cills, etc., can be trenched by fitting a set of Huther pattern multiple grooving saws to the top tenon spindle.

Corner Lock Sash Joints

This type of joint is not only stronger but much cheaper to make than the usual mortise and tenon. Three solid grooving saws and a pair of scribing cutters are required. The maker of your machine will supply these if you send a sample of sash stuff. The correct sequence for setting up, if followed, will save time and trouble.

Machine stiles first as should the sash stuff vary in thickness (one lot of machining from another) the necessary adjustment can be made when working the rails. Work with face (moulded side) down on table. For the stiles use the two ¼-in. thick grooving saws, the larger diameter saw with shaped profile to be fixed on the bottom scribing spindle and the other on the top scriber. The distance between the two saws should be ½ in., i.e., the same as the thickness of the third grooving saw *and* the square on the sash stuff. Set the hollow ground saw to cut off the stile ends exactly to the width of the sash stuff. This can be measured from the bottom of the slot cut by the grooving saw on the top spindle, as it cuts level with the rebate. If the bottom rails of some of the sashes are a wider section, perhaps 3½in, the stiles must be worked in pairs, leaving the bottom ends until last. The dead stop and saw will then need moving outwards.

When setting for rails the bottom tenon head must be set to cut the same depth as the thickness left on the stile by the bottom grooving saw.

Set the top tenon head to cut to depth on rebate side up to top slot in stile. Use a stile to set to. Mount the ½-in. thick grooving saw in the top scribing spindle and set to the centre tenon (between slots) on the stile. Set the pair of scribing cutters for face side shoulder on the bottom scribing head.

Adjust cut off saw to cut rail tenons a bare $\frac{1}{16}$-in. short so that when assembling, the cramps can be placed over the joint, putting pressure on the stile. This also allows for the stiles drying in without leaving the rail ends protruding. The special stops for gang tenoning are very useful when working this joint. Three pairs may be worked at each stroke.

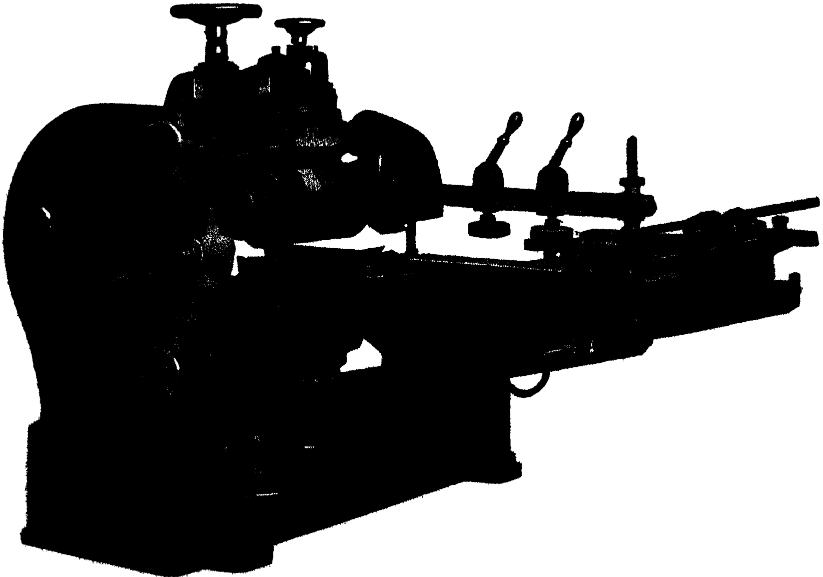

Fig. 123.—Front View of Large Tenoner with Five Motorised Heads and Deep Gap (Wadkin Ltd.)

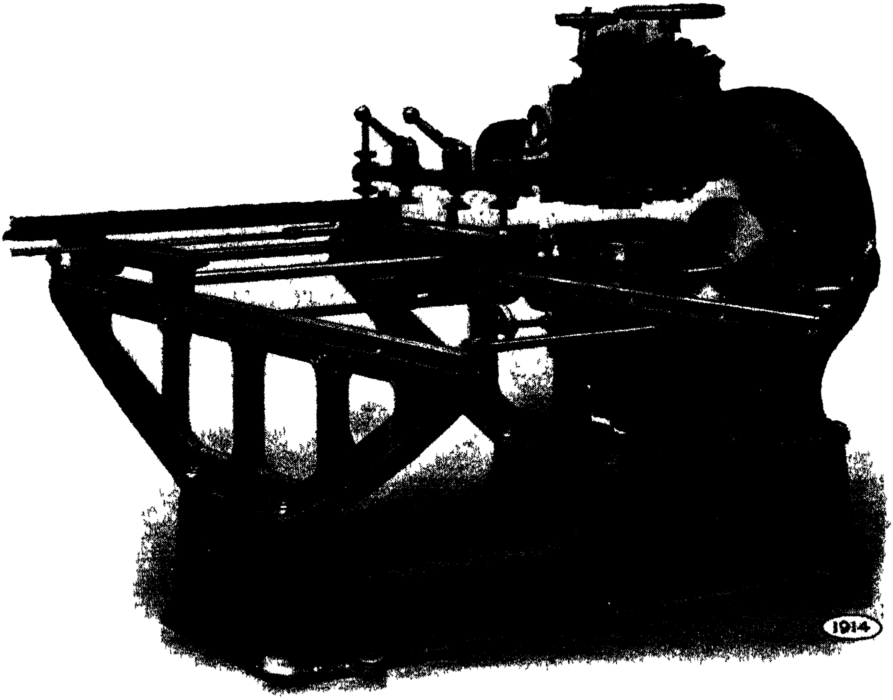

Fig. 123A —BACK VIEW OF A LARGE TENONING MACHINE

(*J. Sagar and Co., Ltd.*)

After finishing the stiles fix another backing piece or turn it end for end and preserve it for future setting up.

Note

This instruction for setting up for corner lock sashes, the dimensions and tools used are for ovolo moulded sash stuff normally 2 in., finishing 1⅞ in., a section which seems to be standard in many parts of the country.

Some districts use a section with $\frac{7}{16}$-in. square instead of ½-in. This would require a grooving saw $\frac{7}{16}$-in. instead of ½-in. Lambs tongue mould would alter the profile of the shaped ¼-in. thick saw.

These grooving saws must be sharpened on the face of the teeth, never on the periphery.

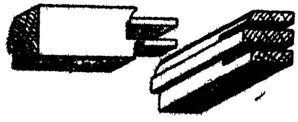

Fig. 123B. CORNER LOCK SASH JOINT

A similar joint has been used on the framing for flush doors. For sashes the joint is pinned with rustless metal pins and a good waterproof glue should be used.

These instructions apply generally to most modern tenoners. A larger machine is shown in Fig. 123.

CHAPTER X

UNIVERSAL WOODWORKER

WHEN selecting a universal woodworking machine, the processes for which it is intended should be considered.

This useful machine is capable of sawing, planing, thicknessing, moulding, mortising, tenoning, boring, dovetailing, trenching, etc.

Not only have they the capacity of separate machines, but two or three operations can be performed by two or three operators simultaneously.

A circular saw and some kind of surface planer are common to most universals. If you are a joiner you require mortising and tenoning, a thicknesser too, is desirable. Cabinet makers and shopfitters must have a vertical spindle moulder, but perhaps find boring sufficient without mortising.

Balance

Make sure that all spindles run at correct speeds, and all cutter blocks are of steel and not cast iron, that the planer will rebate and has shearing cut and that all revolving parts are *dynamically* balanced. Static balance is not sufficient.

In giving a few instructions for working a Universal we make no apologies if our remarks appear obvious and elementary, we write for the person who does *not* know.

CIRCULAR SAW BENCH

All saws should be packed. To do this, screw strips of hardwood on either side of the gap under the table top so that they almost touch the saw and form a ledge on either side to hold the *packing*. Felt or tow wrapped around a thin piece of wood or cardboard and dipped in oil makes a suitable packing. Pack the front half of the saw on either side from the gullet almost to the collar, not too tight, but just pushed down easily with the fingers. A piece of wood should be fitted to fill the gap from the end to the packings. This serves the double purpose of preventing strips of wood from getting down and wedging the saw and also keeps the packings from creeping forward and getting into the saw teeth. It is not necessary to pack the rear half of saws such as are used in a Universal.

Ripping

Make sure that the fence is parallel with the saw, set screws are generally provided behind the fence for this purpose. Adjust the sliding front plate of the fence so that the front end is opposite the gullets of the saw teeth. If the fence is too far forward the saw will not cut accurately and may bind and throw the wood back. Always keep a push stick handy, i.e., a piece of wood 12 inches by 1½ inches by ¾ inch notched at one end, to give the final push as you finish the cut. Never put your hand over the saw to pull the wood through. The riving

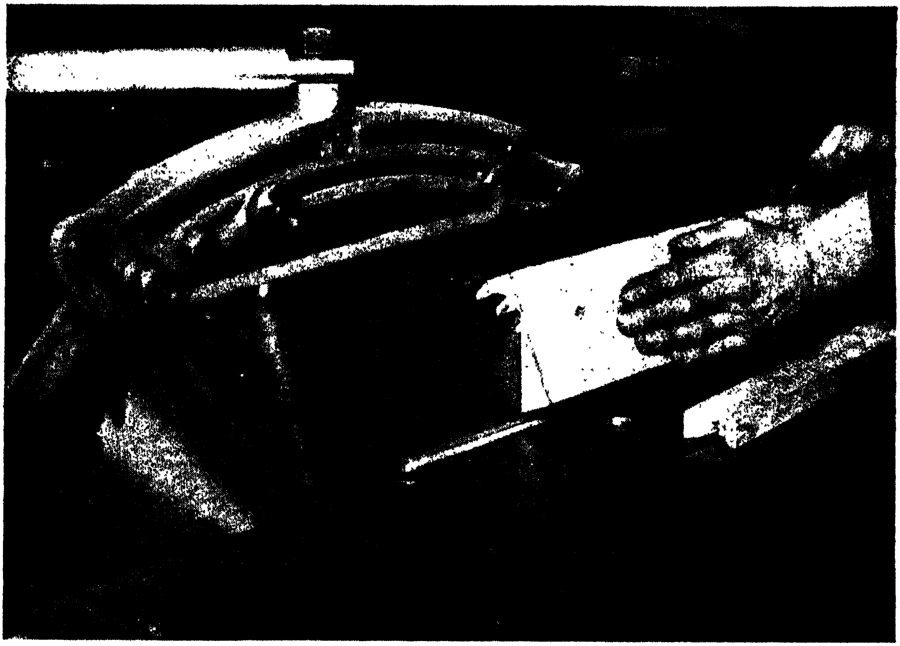

Fig. 124.—Bevel Cutting on the Saw bench

The fence can be canted to various angles to the table in order to cut the required bevel.

knife and guard should always be used, *especially* when using the saw single-handed. It is the back of the saw which proves dangerous. A circular saw cuts best when the teeth just clear the top of the timber, and as the larger the saw the thicker the gauge, cutting thin stuff with a big saw is wasteful.

Bevel Cutting

The fence should be arranged to cant to various angles to the table so that angular sections such as sills, corner posts, tilting fillets, etc., can be cut.

Rebating

If your saw table has rising and falling motion, rebates can be cut with a small saw. Raise the table until the saw projects the required depth of the rebate, then put all the pieces through; repeat the process for the other cut and be careful that the lath cut-out does not shoot back as you finish the second cut—the push-stick is useful here. By canting the fence for one or both cuts an angular rebate can be cut.

Ploughing or Grooving

Grooving saws can be used in the saw bench, but the best tool for grooving is a wobble or drunken saw. It has the advantage of being adjustable from ⅛-in. to 1¼-in. or more, according to its diameter and speed, works freely, and with little power. Owing to the comparative low speed of the saw spindle the

Fig. 125.—RIPPING, SHOWING USE OF PUSH-STICK

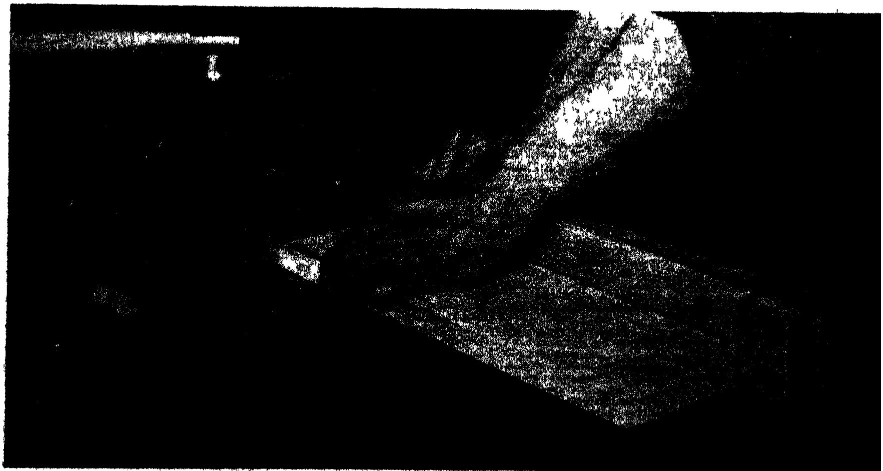

Fig. 126.—CUTTING A DRAWER FRONT

An example of dimension sawing with hollow ground cross-cutting saw and sliding fence with length gauge.

wobble saw should be 12 inches diameter. If your machine gives two speeds, the highest should be used for this tool.

Trenching across the grain can be done with the wobble saw, but trenching or dado heads do a better job, though they are more costly.

When rebating or ploughing, the fence plate should be pushed well forward. It is often an advantage to screw a wood facing to the iron fence, the full length of the table. Both these operations can be done more easily on the planer or spindle moulder if your Universal is so equipped.

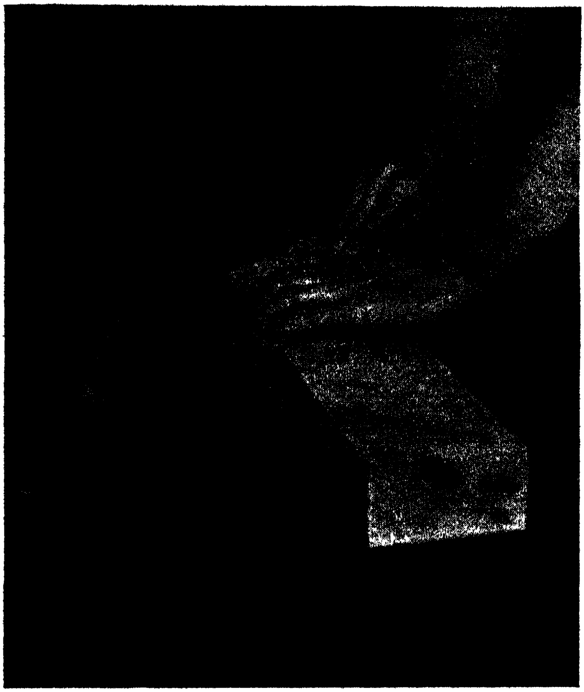

Fig. 127.—Mitreing with Dimension Saw and Sliding Fence

Cross-cutting

This can be done by removing the fence, but if cutting long pieces, take care to support the overhanging end. It is easy to buckle a saw when cross-cutting long timber.

Dimension Sawing

The saw-table should have a groove parallel with the saw. Get a slide to fit. Some Universals are provided with one which can be set to any angle and is most useful for cutting mitres accurately, small blocks, drawer fronts, etc. To get the most out of this you should use a special dimension saw—these are hollow ground and do not require any set on the teeth, and if kept sharp, leave a smooth clean finish which does not require planing. If a length gauge is fitted to the cross-cutting fence (Fig. 126), any number of pieces can be cut to dead length. Square or mitred, shoulders of tenons, balusters, brackets, corbels, etc., can be cut in this manner.

No tool has gained in popularity in recent years as much as this, with joiners, shopfitters, cabinet makers and most woodworkers.

One maker offers at small extra cost a sliding table fitted to the saw bench of the Universal which extends the squaring and dimension cutting process to larger stuff, such as plywood panels, drawer bottoms, stair treads and risers, box lids, sideboard tops, etc.

Our previous note under "ripping" requires qualifying here; if your saw

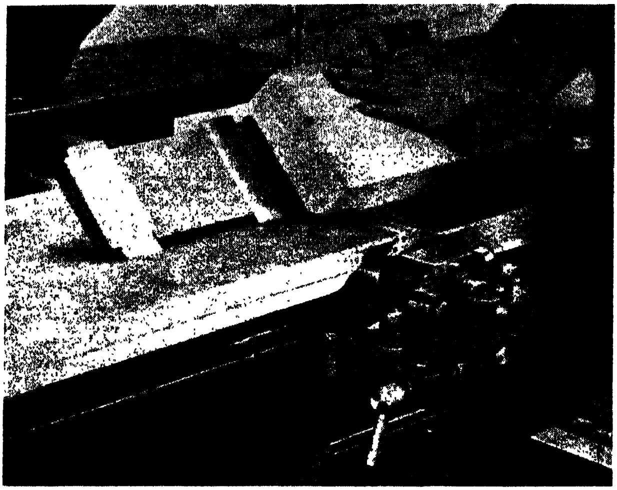

Fig. 128.—USING THE PLANER FOR CHAMFERING
The fence is canted to 45°.

spindle has only one speed—as most have—buy a dimension saw larger than is actually required to cross-cut the thickness you use, so that the teeth on the larger periphery will be travelling faster. A cross-cutting saw can be run much faster than a rip saw.

Sharpening

Keep the saws sharp. Forcing a blunt saw, or one with insufficient set heats, blisters and buckles it. Sharpen with a file having a round edge, the fronts of the teeth first, always getting well into the gullet. Finish with a stroke or two on the tops. File the whole length of the top, not just the point, or the heels will soon be higher than the points.

Rip saws for hardwood do not require as much set or hook on the teeth.

Cross-cut saws require no hook and very little set. Hollow ground saws no set.

All new saws require stoning down before being sharpened; hold a piece of stone or old emery wheel on

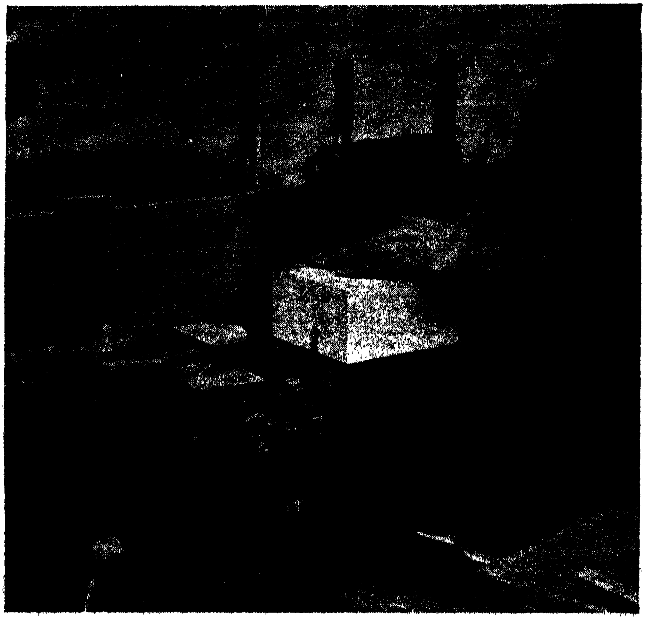

Fig. 129.—REBATING ON PLANER
First position, showing front table lowered.

the saw table, lightly touching the teeth as the saw revolves—this ensures every tooth cutting and makes a great difference in the work.

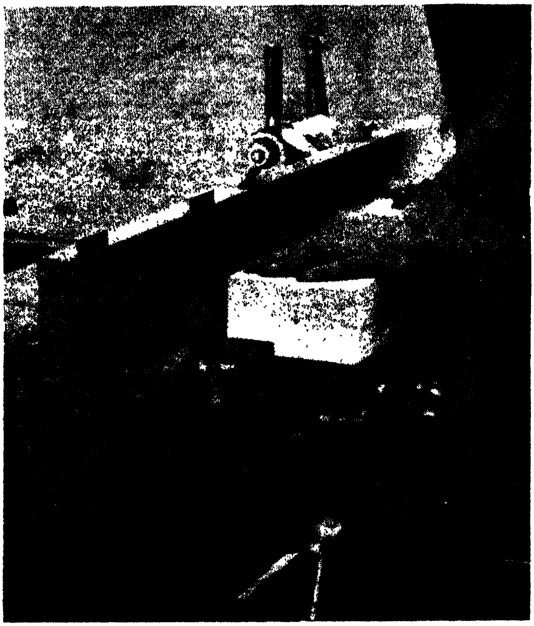

Fig. 130.—Rebating on Planer
Second Position.

THE SURFACE PLANER

The surface planer has two tables, the front table being the one you stand by as you feed the wood to meet the cutters as they revolve towards you, and the back table the one farthest from you. Both tables must have vertical adjustment. To operate, set the back table exactly level with the cutters and lower the front table below the cutting circle to give the depth of cut required.

Plane the best side first. If the timber is badly twisted take a heavy cut first until the high corners are reduced, then raise the front table and finish with a lighter cut. You cannot help planing "out of twist" if machine is in order, and this is a big advantage, as stock stuff machine-planed bought from a mill has usually been through a four-cutter under high-pressure rollers and is not "out of twist."

You can now plane the edges, holding the planed face to the fence, which can be set either square or canted to suit your requirements.

If your timber is to be split by the saw—it is often a good plan to plane one face and perhaps one edge before you saw it.

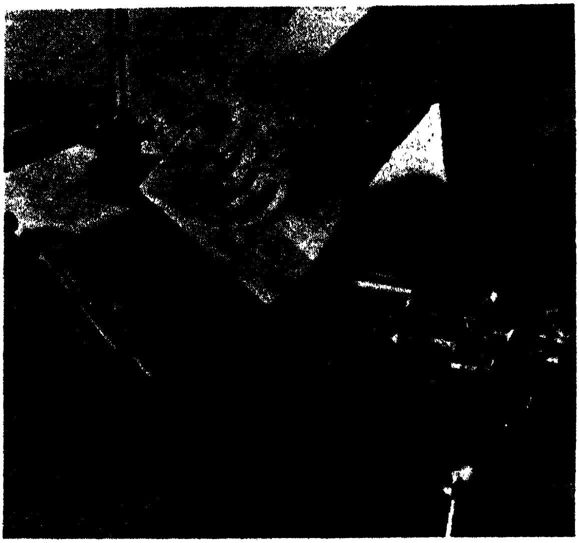

Fig. 131.—Stop Chamfering on Planer—First Position
Generally called "dropping on."

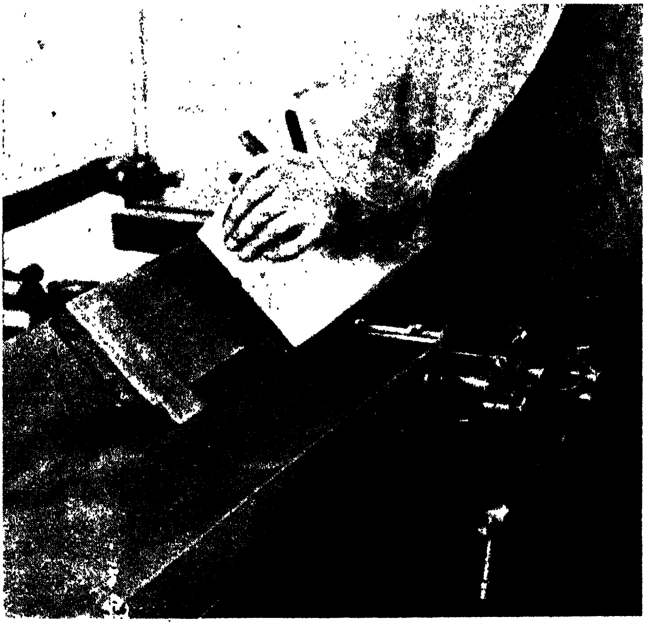

Fig. 132.—STOP CHAMFERING ON PLANER—SECOND POSITION

Jointing

Long tables are an advantage for jointing, and reduce the fatigue when planing long heavy stuff. To produce a good joint, set the back table carefully and take a light cut, feeding slowly and holding the timber firmly on the back table. The joint should not require any hand planing.

Tonguing and Grooving

Provided the machine is aranged to take extra cutters, tongued and grooved joints can be made in the same operation: Fix a pair of grooving cutters and a pair of tonguing cutters side by side, draw the fence forward so that only one pair of cutters are exposed, say the grooving cutters, joint one edge of all boards, then push fence back exposing tonguing cutters and work that on the other edge of each board.

Chamfering

This is done by canting the fence to 45° and lowering the front table the required depth.

Rebating

The cutter block of the planer should be flush with the front edges of the tables and the front ends of the cutters ground back a little and set about $\frac{1}{32}$-in. proud of the table edges.

Lower the front table the depth of the rebate and set the fence from the table edge the width of the rebate.

To produce clean-finished rebates without setting up any special cutters is a great boon to most woodworkers, so make sure when purchasing a Universal that this is possible (many foreign and some British machines are lacking in this respect).

Stop Chamfering and Stop Rebating

Lower *both* tables the required depth, put chalk marks on the fence where the cutters begin and finish, and pencil marks on your timber on outer edge where your chamfer begins and ends.

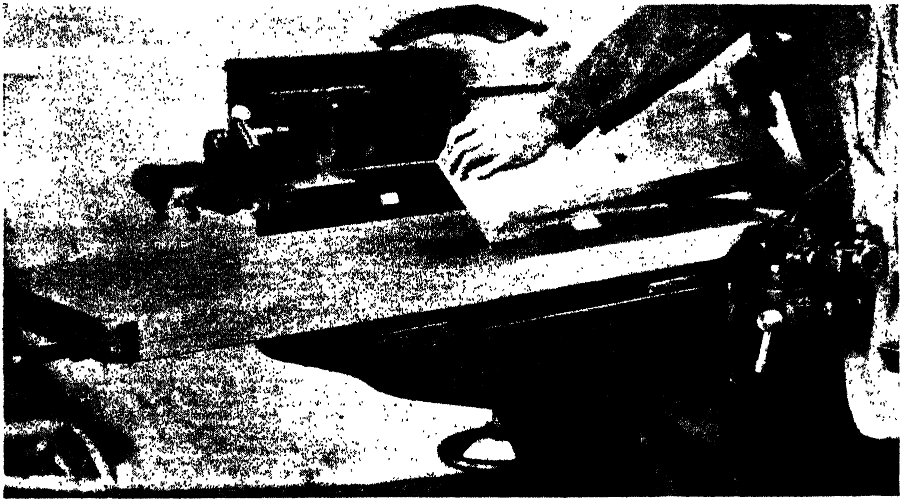

Fig. 133.—STOP CHAMFERING ON PLANER—THIRD POSITION
Chamfer finished—lifting clear.

With your left hand hold the far end of the timber on the back table, the pencil mark and chalk mark coinciding (Fig. 131). With the right hand gently lower the back end of the timber down on to the cutters (Fig. 132), keeping it up to the fence all the time. Feed forward until the required length is chamfered or rebated, shown by the pencil mark, then with the right hand lift the back end clear (Fig. 133).

"Dropping On"

Although this is known as "dropping on," don't "drop," but lower slowly and hold the wood firmly, especially when taking heavy cuts, or the timber might be thrown back.

A long fence is an advantage for this operation.

When putting fresh cutters into the block it is worth while taking care to set them both alike. If one is a fraction farther out than the other, it will do all the work. When you have planed a few pieces, stop the machine and examine the cutter edges and if they are not both cutting, alter one of them. Blunt cutters make hard work, give poor results, waste power and spoil the bearings. Keep cutters sharp. Finish with a fine stone, as a fine edge keeps sharp longer.

Taper Planing

Tapered legs are largely used for tables, cabinets, chairs, etc., and can be done quickly and easily on the surface planer, without any special cutters or appliances. Suppose you require some 4-in. square legs tapering to 3-in. square near the bottom and retaining the original 4-in. square for say 1½ in. at the foot:

Lower the front table ½ in.; carefully lay the top of the leg on the back table with the part, say 4 in. down, where you wish the taper to start, over the centre

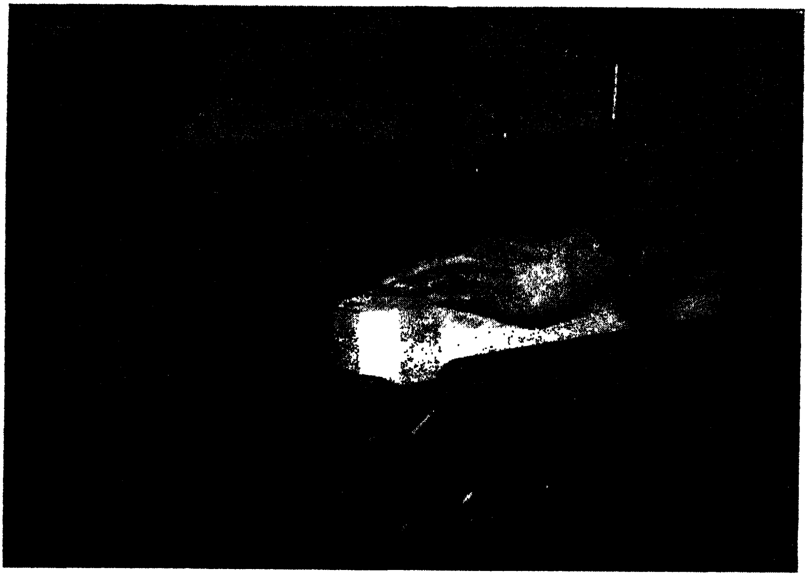

Fig. 134.—TAPER PLANING
Shaping the foot of leg. Leg reversed.

Fig. 135.—TAPER PLANING ON THE SURFACE PLANER
This shows second position in cutting a taper on a table leg. The front table of the planer has been lowered. Top of leg has been placed on back table and the foot is being gently lowered on to front table, ready to start cutting.

of the cutter block. Hold the top part of the leg with the left hand and with the right hand gently lower the foot of the leg on to the front table; feed forward slowly, keeping the foot of the leg on the front table, until the cutters are 1½ in. from the end, then lift the bottom end up clear of the cutters. Repeat on the other three sides; hold the leg firmly during this operation—the cut gets heavier as you go—and feed very slowly at the finish because the cut is end grain and a good finish is desirable. Many variations are possible; if you desire the taper to start with a curve or scallop at the top, lower the back table a little but not as much as the front table and the leg must now be "dropped on" as explained under "stop chamfering"; feed forward as before to within 4 ins. or 5 ins. from the end; now turn the leg round and lay it on the front table and feed the bottom end to the cutters until you have say 1 in. or 1½ in. of square left. You now have a square turned effect and a much cheaper and better job than by cutting the legs to shape on the band-saw and then cleaning up with spokeshave and plane. The same job can be done equally well, in fact easier, on the vertical spindle if it is capable of carrying the necessary width of cutters. A circular cutter block is, of course, best and safest; the spindle fences will have to be made longer by screwing wood fences to them.

If the taper is required through to the end, take care, for the last piece may break away. To avoid this, before tapering the leg, reverse it and take the bottom corners off as Fig. 134. When tapering through, before reaching the end, move your right hand forward from the position shown in Fig. 136.

Moulding on the Planer

The vertical spindle, referred to later, is superior in every way for moulding, but if your Universal does not include one, the planer should be arranged to mould by having some form of removable caps or plates on some portion of the

Fig. 136.—TAPER PLANING—THIRD POSITION

End of cut. Ready to lift clear.

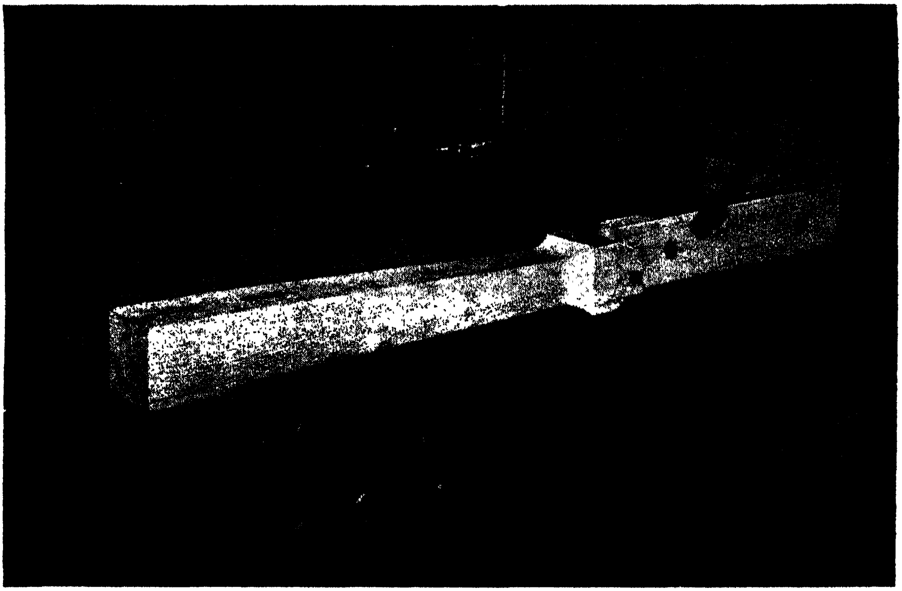

Fig. 137.—HOLLOWING OR SCALLOPING TOP OF LEG

Note both tables lowered—front one more than the back. Also back stop clamped to fence to prevent leg being thrown back as it is lowered—this being a heavier cut.

cutter block so that cutters can be fixed, and some means of enlarging part of the gap or "throat" of the machine for the moulding cutters to swing. Many of our remarks under "Vertical Spindle" apply here and we shall only mention the few jobs peculiar to the planer. Moulding and planing at one operation is useful at times; especially with wide stuff such as skirting, but it must be well sawn and not twisted. Occasionally certain forms of circular moulding are more easily moulded on the planer, i.e., when the mould is on the face of curved pieces, architraves over circular headed windows or doors, stair strings, drainer boards, etc., but only large radius curves and moulds with plain members can be done on the planer. Cut a piece of wood a little thicker than the piece to be moulded and shape one edge to fit the quickest part of the curve. Secure this to the planer table to act as a fence. If you are removing the whole or a large part of the face of the wood, fix a lath to the back table to receive the mould, or it may tilt over and cause an accident.

Thicknessing

Adjust the table to the required thickness, by the gauge, and feed the stuff in at the opposite end to that when surfacing. Long stuff should be supported and not allowed to drop as it leaves the machine.

Very thin stuff is best planed on the top of a thick piece—passing both through together. Thicknessing can be done straight from the saw, if well sawn, but it will not be out of twist unless one side is first put over the surfacer. The anti-friction rollers in the bottom table should be adjusted only just above the sur-

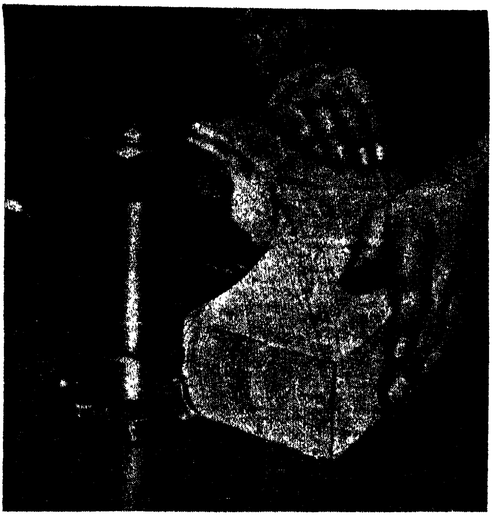

Fig. 138.—Moulding Circular Piece Without a Fence (Light Cuts Only)

face of the table. If too high the ends of the timber will be dipped off. For wet or rough sawn stuff it is sometimes necessary to raise these rollers. The table and rollers should be cleaned of resin and dirt with paraffin or oil.

Boring and Mortising

Boring and mortising are possible on practically all "Universals" in some form. Boring requires little comment; the boring bits are usually fixed in either the saw or planer spindles and owing to the high speed, twist bits, such as Jennings pattern, which are most commonly used, become difficult to manage, especially in the larger sizes. If the bit "snatches," file the screw nose very slightly until it feeds reasonably.

Slot mortising by means of three winged bits, though rather slow gives a clean hole but with round ends.

Several makers have recently fitted square hollow chisels and augers to their Universals, which are undoubtedly the best mortising tool possible horizontally. When using these, take care that the auger cutters are not pushed back against the end of the chisel or both will soon be ruined. Keep the augers $\frac{1}{16}$-in. forward from the chisel.

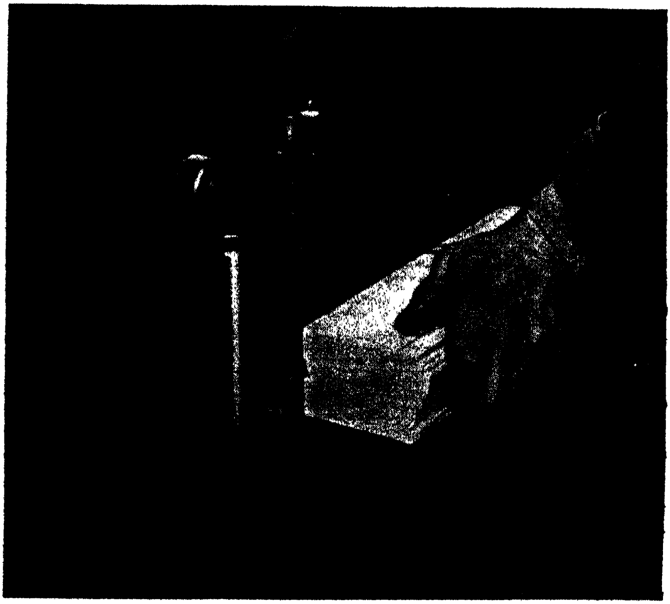

Fig. 139.—Moulding Straight Handrail
Using one "French" cutter in slot spindle.

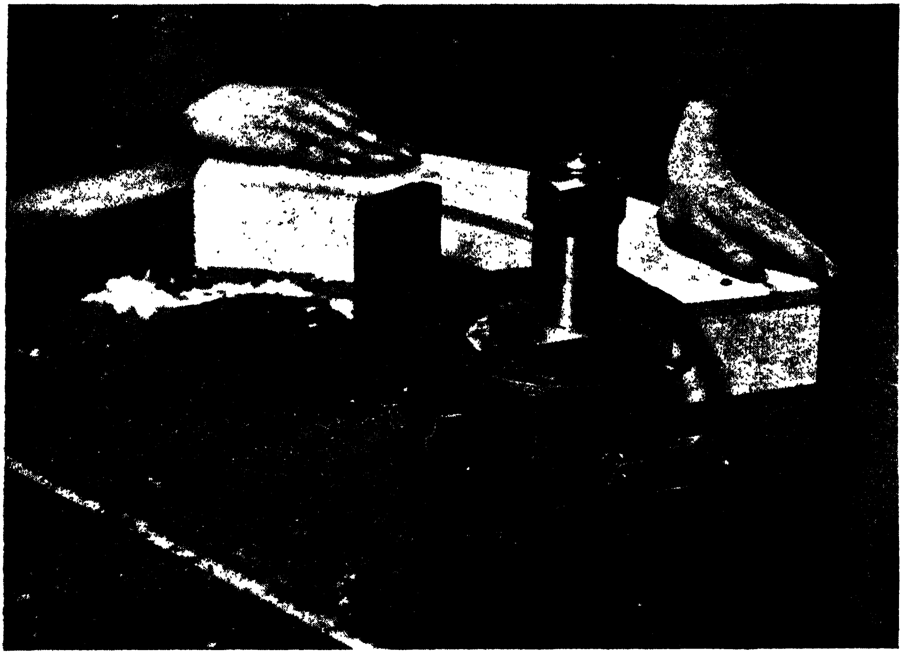

Fig. 140.—USING THE RING FENCE
Moulding and rebating sash head with square block. First position, leading in.

In addition to boring, slot-mortising and hollow chisel mortising, the Universal here illustrated—and several other makes of somewhat similar machines—is fitted with a superior tenoning arrangement.

A standard tenoning cutter head with flat and shoulder cutters is fitted on the extended planer spindle, which carries the boring and mortising bits.

The mortising table is turned 90 degrees to bring it endwise to the machine; the timber is cramped to the table and fed over the cutters which cut a perfect tenon. Length gauges are provided and equal or unequal or splayed shoulders can be cut.

Vertical Spindle

When selecting a Universal woodworker do not hastily say "I never do any circular work," for very many people who never touch a curved piece or seldom stick a mould find their spindle moulder invaluable. It is as useful to a wheelwright as in a cabinet shop.

Moulding, rebating, ploughing, straight and irregular shapes, tenoning, scribing, dovetailing, stair string and other housing, corner locking, jointing, planing and thicknessing can all be done on this part of the Universal.

There are several methods of carrying the cutters on a spindle moulder.

The Square Block

This has a dovetail slot on each side with bolts and nuts to suit and is used for heavy work, especially when several members are required on the same piece, such as a door or window frame section, having mould, rebate and perhaps a throating. This can all be done in one operation, a pair of moulding cutters being fixed on opposite sides at the bottom end of the block, a pair of square or rebating cutters on the other two sides at the top and if required the small throating cutters at the top end above the moulding cutters. Always put a double thickness of paper between the cutters and the block and always use pairs of cutters to preserve the balance. If you have stock patterns which you often repeat it is a good thing to get extra cutter blocks so that you can keep them set up ready to slip on the spindle.

The Slotted Collars

These are quickly set up and are useful for both straight and curved work. If the cutters project only the depth of the mould required, a fence can be dispensed with, the wood being held against the face of the collars. Always use cutters in pairs to ensure balance; they work easier and cleaner.

Rebates, small moulds, tongues and grooves, beads and nosings, etc., can all be worked on the collars. With nosings or any mould such as a picture moulding where the cutters remove the whole face of the timber a fence must be used, either the straight fences or the ring fence referred to later. Collar cutters must be exactly the shape required as you cannot "pitch" or "kick" them to suit, like you can on the cutter block.

The Slot or French Spindle

This is more generally used to-day than formerly, both for hard and soft wood. Only one cutter is required. It is held in a slot through the centre of the spindle. The cutters are made from untempered steel. Grind with a short

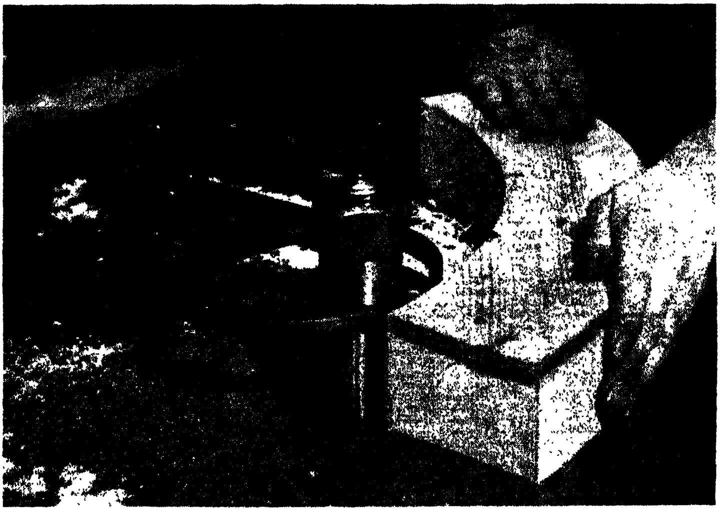

Fig. 141.—Moulding and Rebating Sash Head with Square Block
Second position, full cut.

bevel and after sharpening with the oilstone, turn the edge over like a hand scraper, to form a burr on the face, or flat side. A French cutter really scrapes, it does not cut.

Owing to the small circumference of the cutting circle a high speed is desirable, at least 5,500 r.p.m.

This method is eminently suitable for small radius work and any irregular shape. It is best for hard and cross-grained woods and end grain, such as panels, newel caps, wood letters, shaped handrails, mirror frames, brush backs, chair frames, coach frames and the ordinary joiners' and cabinet makers' work.

Excepting with very small cutters, it is best to use a balance cutter on top of the working cutter and projecting the opposite side; both can cut if desired, say for sash stuff, mould and rebate.

The Ring Fence

This is absolutely necessary for circular work on the cutter block. Suppose you have a circular head for a sash or door frame. Make a wood template the size and shape of each "sweep" about ½ in. thick; plywood will do. Mark out the plank and cut out the pieces on the band saw, leaving a bare $\frac{1}{16}$-in. outside the pencil marks; fasten the template with two or three screws to a "sweep" and, having set up the required cutters on the block, fix the ring fence over the cutters so that when the edge of the template is against the ring fence, the cutters project sufficiently to shape the timber to the marks (the best way is to mark the mould, etc., on the end of one piece and set the cutters to it).

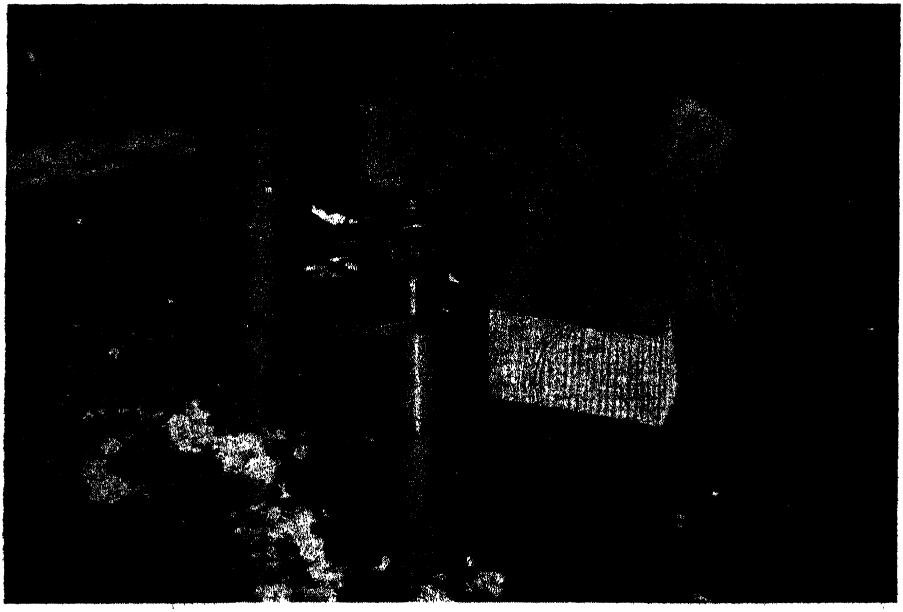

Fig. 142.—VERTICAL SPINDLE MOULDER

Facing up a "sweep" after band sawing with circular cutter block, ring fence and template screwed to wood. First position—leading in at side of eccentric ring.

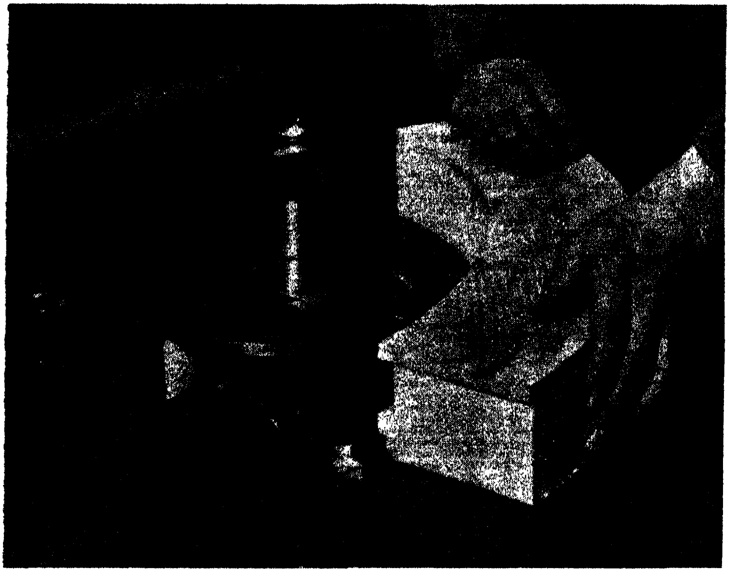

Fig. 143.—VERTICAL SPINDLE MOULDER
Taking full cut template now on front of ring.

The ring fence is made eccentric to give a gradual lead in at the beginning of a cut, especially with circular pieces as the ends are short grained and would break off if the full cut were taken. Start with the template to the side of the ring (Fig. 140) and slowly work round to the centre where the cutters have their full cut (Fig. 143).

For heavy cuts or cross-grained timber, it is often an advantage to take a rough cut and finish with a fine cut. The ring fence enables this to be done without two settings. Circular work on collars or slot spindle can be done without fence or template but the curved face must first be cleaned up true to shape with template and ring fence after it leaves the band saw. Square cutters on block or in collars will do this.

A circular cutter block is useful on the spindle for cleaning up sweeps (Fig. 142) and small planing jobs, also rebating. It is safer and always set up ready to put on the spindle. Narrow stuff can be thicknessed by fixing the straight fences behind the cutters and passing the timber between fence and cutters. Side springs to hold timber up to fence *must* be used for this operation and a top spring is advisable to keep it firm on the table.

The ring fence can be fixed on the table below the cutters if it suits the job better. If the stuff is narrow and deep, make the template wide and let it rest on the table (against the ring) to give greater stability and safety.

How to Arrange the Cutters

Arrange the cutters to work on the underside of the wood, to keep the face side and edge to table and fence, and the wood covers the cutters.

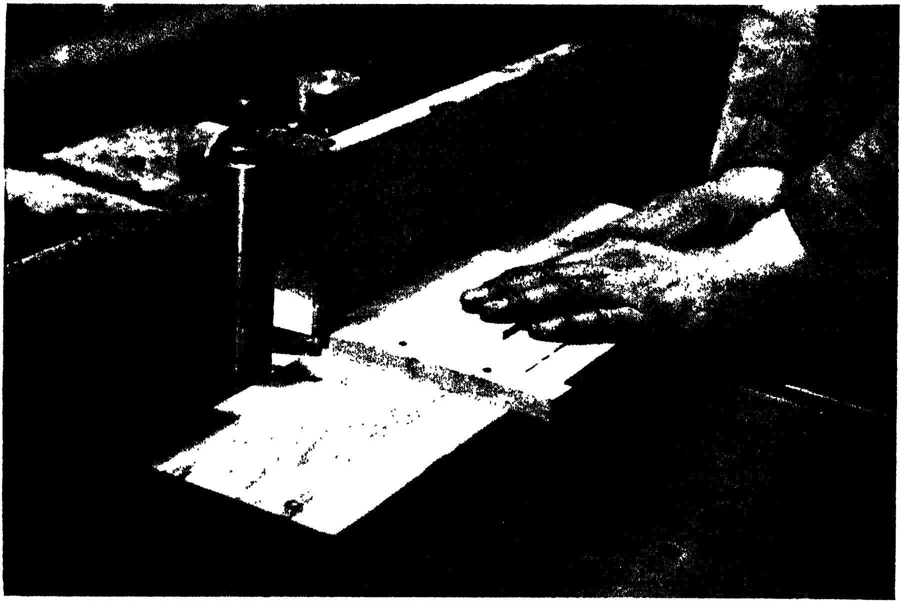

Fig. 144.—RAISING PANELS ON SPINDLE MOULDER (SLOT SPINDLE)
With the cutter working on top of the wood.

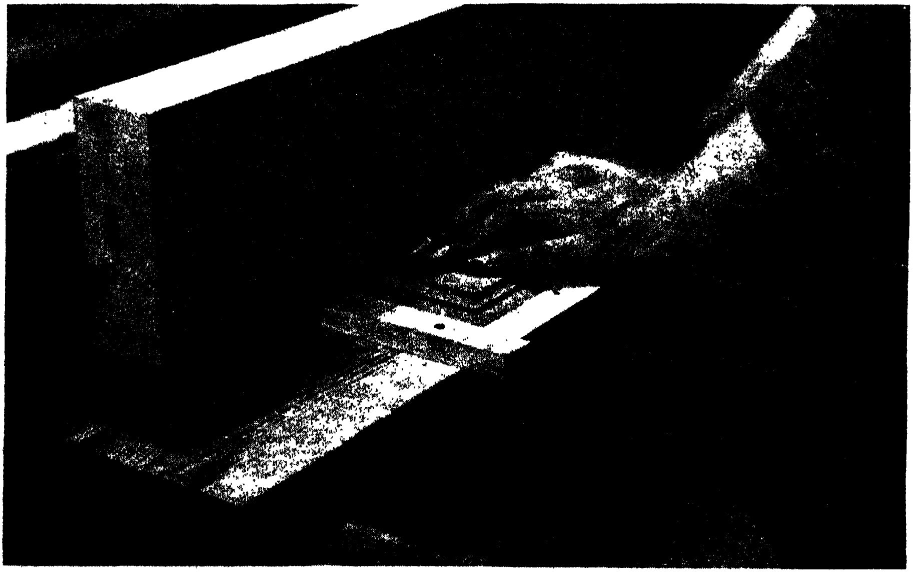

Fig. 145.—RAISING PANELS ON SPINDLE MOULDER
Same operation as in Fig. 144, showing piece of wood screwed to fence plates and covering the cutter. Figs. 144 and 145 also illustrate the use of a jig for handling small pieces.

Fig. 146.—Type WI/T Motor Driven Universal Woodworker

(Thos. Robinson and Son Ltd.)

There are exceptions. If a mould and rebate are being struck at one operation, the mould being at the bottom, the rebating cutters will be exposed at the top. When raising panels the cutters are usually worked on the top, ensuring edges of even thickness to fit the plough groove in framing. Moulds of awkward section such as picture mould, angle fillets, ridge roll, some architraves, etc., are easiest to work with the cutters on the top so that there is a flat face to rest on the table. In all such cases, a piece of wood screwed to the fence above the cutters and projecting the full swing of the cutters makes the operation comparatively safe.

When to Use the Wobble Saw

Reduce the work of the cutters wherever possible by cutting a corner off or a V out on the circular saw, or roughing out a heavy mould by a few cuts with a wobble saw (a most useful tool on a spindle for grooving, etc.).

When ordering cutters, think whether you are likely to require them for any circular work; it makes a difference which hand you get them; i.e., an ogee cutter to mould plinth flat on the table would not mould a circular plinth, but it would mould a circular or elliptical architrave.

Large moulds with many members are best worked by several pairs of simple cutters. The cutters are more likely to come in useful for other jobs and are easier to grind and sharpen.

Striking Small Moulds

When small moulds are being struck on planer or spindle use side springs and holding down springs on table and fence or purchase a "Shaw guard" if one is not provided.

Glass Beads and Slips

For very small sections such as glass beads and slips it is best to plane up larger pieces and run the mould on each edge or corner, if the stuff is square, afterwards cutting them off with a fine saw; this applies also to circular beads.

Caps for Newels

For small caps for beds or newels, use a jig, i.e., a piece of board to which you can sprig (or nail) or screw several caps, or a box with one edge open which will hold several pieces. Always work the end grain first, then when the sides are worked the spelch at the corner is removed.

Tongued and Grooved Joints

If tongued and grooved joints are required, the tongue and groove can be put on in the same operation as "shooting" (planing straight) the joint, if the cutters are carefully set, on either planer or spindle.

Dovetailing, Stair String Housing, etc.

Dovetailing, stair string housing, scribing, etc., are done by special attachments which do not usually form part of the standard equipment of a Universal.

We have not finished with the work that can be done on a good Universal—the above is only a sketch of general principles, which are further elaborated with examples and details in later articles in this work.

In most of the illustrations shown in this article, machine guards have been dispensed with, in order to show the operations more distinctly. Where guards are shown (Figs. 1 and 3) for clearness, they have been raised farther from the saw than the regulations direct.

Whether you are a joiner, estate carpenter, cabinet maker, motor body builder, pattern maker, building contractor, technical school instructor, on the maintenance staff of mill, works or institution, or an amateur woodworker, you cannot do better than invest in a Universal woodworker, as long as it is of recent design and reliable quality. The best Universals to-day are equal in output and efficiency to separate machines.

The latest Universal Woodworker, comprising rising top sawbench, surface planing and thicknessing machine, and vertical spindle moulder, with hollow chisel mortising and tenoning, has three built-in motors, with Vee belt drives, all enclosed.

This combination is in fact a complete plant, each unit of which has the efficiency and capacity of separate machines. Three operators can often work at one time, two can always work together.

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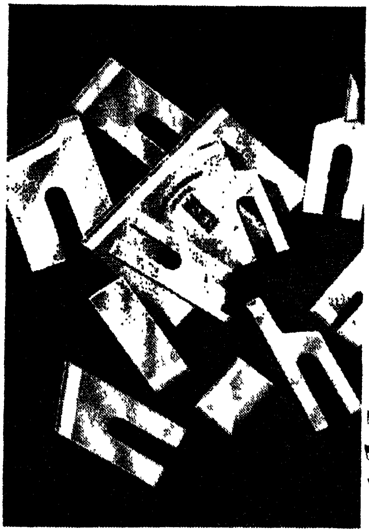

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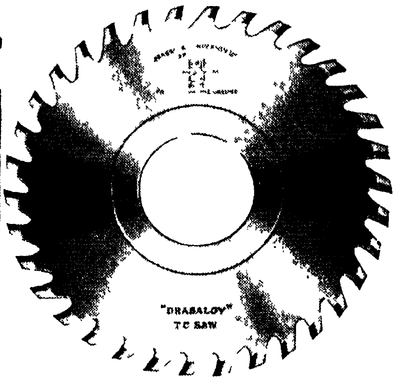

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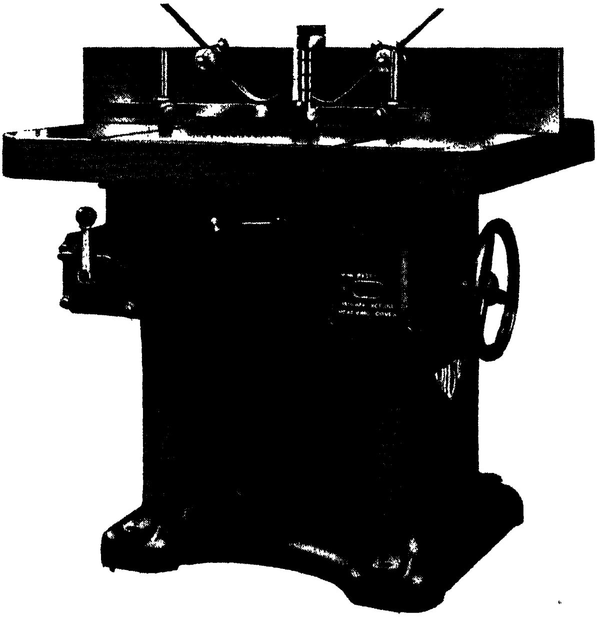

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